Environment Canada

Environnement Canada

Western and Northern Region

Région de l'Ouest et du Nord

Environmental Protection Service

Service de la protection de l'environnement

Removal of Contaminants from Distant Early Warning Sites In Canada's Arctic

by

A. Holtz
M. A. Sharpe
M. Constable
W. Wilson

REMOVAL OF CONTAMINANTS
FROM DISTANT EARLY WARNING
SITES IN CANADA'S ARCTIC

W&NR-86/87-CP(EP)-16

Environmental Protection
Western and Northern Region
Edmonton, Alberta
December, 1986

Executive Summary

In July 1985, Environmental Protection (EP), Environment Canada (EC), provided assistance to the Department of National Defence (DND) and the Department of Indian Affairs and Northern Development (DIAND) in the removal of hazardous materials from 21 abandoned Distant Early Warning (DEW) stations and one abandoned U.S. Coast Guard site across the Canadian Arctic. The stations were located from the Yukon/Alaska border to the east side of Baffin Island at 160 km intervals. The objective of the clean-up program was to remove surface contaminants such as polychlorinated biphenyls (PCB) and petroleum products (POL) from abandoned sites and identify areas of buried materials which could pose environmental risks in the future.

Approximately 7,300 kg (out of an estimated 10,000 kg) of PCB contaminated liquid contained in 2,499 pieces of electrical equipment were removed from the abandoned sites. In addition 540 drums of varsol, lubricating oil, diesel fuel and aviation fuel were located on these sites. Of these, 202 drums were burned; the remaining barrels were left unburned because of fire hazard to surrounding areas, the non-combustable nature of the liquid, or the possible hazard posed to personnel attempting the ignition. At 13 sites the station fuel tanks remained intact, and at four of these sites diesel fuel was left in the station tanks.

From evaluation of the information gathered from the site evaluations, it was determined that three sites can be considered contaminant-free. Nineteen sites require further soil sampling to determine the extent of PCB contamination in dumpsites and/or the extent of surface contamination. Based on observations at several sites and considering the physical properties of PCBs, any remaining equipment or PCB residue buried in a permafrost zone of these sites is not considered to represent a threat to the environment.

Conclusions and Recommendations

1. Surface contaminants and contaminated equipment have been removed from all the abandoned DEW line sites. The remaining residual contaminants at some of these sites should present no danger to humans from transient use, or to the environment. No clean-up operations should be conducted before a detailed sampling program has delineated the size of the problem.

2. The Horton River, Clifton Point and West Baffin sites were considered contaminant-free. It is recommended that no further evaluations are needed because all the PCB containing equipment has been removed, composite soil analysis indicates only low level residues remain and POL has been removed or destroyed.

3. Five sites are considered to still be contaminated for purposes of extended human use. The sites are Atkinson Point, Tununuk, Cape Peel, Kivitoo, and Sarcpa Lake. These sites met all of the following conditions:
   a) The presence of PCB residues (greater than 10 ppm.) in a sample of soil or a composite sample.
   b) Seasonal use by people for various activities.
   c) The evidence of PCB residues leaching from a dump site.
   d) Equipment known to contain PCBs was not accounted for in the inventory of equipment removed and evidence of buried material existed on-site.

   These sites should be considered a priority for re-evaluation, especially if continued use is anticipated.

4. Fourteen remaining sites may still be contaminated for purposes of extended human use because at least one of the following conditions are met:
   a) Equipment was missing from the site and no evidence of burial was evident;
   b) Low level contamination (less than 50 ppm) existed on site;
   c) POL remains at the site.

d) Equipment was removed (leaking) and soil samples indicated that residual PCB remained at this location.

These sites should require further evaluation if they are to be used as permanent installations (i.e. resorts, community centres or military establishments), or if the use involves contaminant-sensitive activities such as food processing or human habitation.

5. An inventory of all the communities near the abandoned sites should be conducted to determine if hazardous material was taken from the sites into the communities. For example, during the clean-up of the Keith Bay site, equipment missing from the site was located in the nearby community of Pelly Bay. This may be common to other communities in close proximity to abandoned sites.

6. It is recommended that a Priority Action Plan be prepared by the responsible agencies to deal with the residual level of contaminants remaining at the nineteen sites.

Acknowledgments

The leadership of Lt. J.S. Ponton and MWO R. McKinnon (DND), as well as the excellent work of the work crews and flight crews, is acknowledged and appreciated. Without their dedication and long hours of planning, the success of the clean-up would not have been accomplished. The assistance of Magnus Bourque (EP, Inuvik Office) and Tom Nesbitt (EP, Iqaluit Office) is acknowledged. The invaluable advice provided by E. Del Degan (DIAND Field Officer) and C. Chouinard (DIAND Field Officer), and the helpful suggestions and dedication of R. Roberts (NRC) assisted the EP field advisers in completing their tasks efficiently.

The helpful hints of reviewers Warren Fenton and Margaret Ault Brakel, along with many others, helped produce a better-organized final copy. The fast eyes and fingers of the typists are acknowledged for picking up errors and suggesting little changes to make this report easier to read.

Table of Contents

		Page
Executive Summary		i
Conclusions and Recommendations		ii
Acknowledgements		iv
Table of Contents		v
List of Tables		vi
List of Figures		vii
List of Appendices		ix
List of Abbreviations		x
1.0	Introduction	1
1.1	Waste Materials at DEW Line Sites	6
1.2	Background	7
2.0	Methods	10
2.1	1985 Clean-up Operation Methods	10
2.2	Laboratory Methods	20
2.1.1	Sample Preservation and Preparation	20
2.2.2	G.C. Analysis	23
2.2.3	Quality Control	23
3.0	Results	24
3.1	Site Evaluation	24
3.1.1	Stokes Point - BAR B	24
3.1.2	Tununuk - BAR C	27
3.1.3	Atkinson Point - BAR D	31
3.1.4	Horton River - BAR E	35
3.1.5	Pearce Point - PIN A	39
3.1.6	Clifton Point - PIN B	42
3.1.7	Bernard Harbour - PIN C	45
3.1.8	Ross Point - PIN D	48
3.1.9	Cape Peel - PIN E	51
3.1.10	Sturt Point - CAM A	55
3.1.11	Hat Island - CAM B	58
3.1.12	Matheson Point - CAM C	62
3.1.13	Simpson Lake - CAM D	65
3.1.14	Keith Bay - CAM E	68
3.1.15	Sarcpa Lake - CAM F	72
3.1.16	Rowley Island - FOX 1	76
3.1.17	Bray Island - FOX A	79
3.1.18	West Baffin Island - FOX B	82
3.1.19	Ekalugad Fjord - FOX C	85
3.1.20	Kivitoo - FOX D	88
3.1.21	Padloping Island - U.S. Coast Guard	91
3.1.22	Durban Island - FOX E	94
3.2	Results of Clean up of Hazardous Materials	97
4.0	Discussion	101
5.0	Conclusions and Recommendations	104
6.0	References	106
7.0	Appendices	107

List of Tables

		Page
Table 1:	Potential Waste Materials at DEW Line Sites	6
Table 2:	PCB Residue Analysis - BAR C	30
Table 3:	PCB Residue Analysis - BAR D	33
Table 4:	PCB Residue Analysis - BAR E	37
Table 5:	PCB Residue Analysis - PIN C	45
Table 6:	PCB Residue Analysis - PIN E	54
Table 7:	PCB Residue Analysis - CAM A	55
Table 8:	PCB Residue Analysis - CAM B	60
Table 9:	PCB Residue Analysis - CAM D	65
Table 10:	PCB Residue Analysis - CAM E	71
Table 11:	PCB Residue Analysis - CAM F	75
Table 12:	PCB Residue Analysis - FOX 1	76
Table 13:	PCB Residue Analysis - FOX A	79
Table 14:	PCB Residue Analysis - FOX B	82
Table 15:	PCB Residue Analysis - FOX C	85
Table 16:	PCB Residue Analysis - FOX D	88
Table 17:	PCB Residue Analysis - U.S. Coast Guard	93
Table 18:	PCB Residue Analysis - FOX E	94
Table 19:	PCB Equipment at Each I-Site	98
Table 20:	Equipment Removed from Abandoned DEW Line Sites	99
Table 21:	Site Status	100

List of Figures

		Page
Figure 1:	DEW Line Stations	2
Figure 2:	Site Plan of a Main Site	3
Figure 3:	Site Plan of an Auxiliary Site	4
Figure 4:	Site Plan of an intermediate Site	5
Figure 5:	Site Sweep by Crew	11
Figure 6:	Equipment Removal from Buildings	12,13
Figure 7:	Identification and Removal of Equipment Outdoors	15
Figure 8:	Soil and Equipment Clean-up	16
Figure 9:	Enviropac Container used to Move/Store Drums	17
Figure 10:	Barreled Equipment Removal	18
Figure 11:	Loading Barrels	19
Figure 12:	Soil Sampling and POL Destruction	21
Figure 13:	Loading Enviropacs into the Buffalo	22
Figure 14:	Site Overview - Stokes Point	25
Figure 15:	SITE PLAN - BAR B	26
Figure 16:	Site Overview - Tununuk	28
Figure 17:	SITE PLAN - BAR C	29
Figure 18:	Site Overview - Atkinson Point	32
Figure 19:	SITE PLAN - BAR D	34
Figure 20:	Site Overview - Horton River	36
Figure 21:	SITE PLAN - BAR E	38
Figure 22:	Site Overview - Pearce Point	40
Figure 23:	SITE PLAN - PIN A	41
Figure 24:	Site Overview - Clifton Point	43
Figure 25:	SITE PLAN - PIN B	44
Figure 26:	Site Overview - Bernard Harbour	46
Figure 27:	SITE PLAN - PIN C	47
Figure 28:	Site Overview - Ross Point	49

List of Figures - Continued

		Page
Figure 29:	SITE PLAN - PIN D	50
Figure 30:	Site Overview - Cape Peel	52
Fugure 31:	SITE PLAN - PIN E	53
Figure 32:	Site Overview - Sturt Point	56
Figure 33:	SITE PLAN - CAM A	57
Figure 34:	Site Overview - Hat Island	59
Figure 35:	SITE PLAN - CAM B	61
Figure 36:	Site Overview - Matheson Point	63
Figure 37:	SITE PLAN - CAM C	64
Figure 38:	Site Overview - Simpson Lake	66
Figure 39:	SITE PLAN - CAM D	67
Figure 40:	Site Overview - Keith Bay	69
Figure 41:	SITE PLAN - CAM E	70
Figure 42:	Site Overview - Sarcpa Lake	73
Figure 43:	SITE PLAN - CAM F	74
Figure 44:	Site Overview - Rowley Island	77
Figure 45:	SITE PLAN - FOX 1	78
Figure 46:	Site Overview - Bray Island	80
Figure 47:	SITE PLAN - FOX A	81
Figure 48:	Site Overview - West Baffin Island	83
Figure 49:	SITE PLAN - FOX B	84
Figure 50:	Site Overview - Ekalugad Fjord	86
Figure 51:	SITE PLAN - FOX C	87
Figure 52:	Site Overview - Kivitoo	89
Figure 53:	SITE PLAN - FOX D	90
Figure 54:	Site Overview - Padloping Island	92
Figure 55:	Site Overview - Durban Island	95
Figure 56:	SITE PLAN - FOX E	96

List of Appendices

		Page
Appendix A	- Analytical Results	107
Appendix B	- Recovery Results	110

List of Abbreviations

m	=	metres
ft	=	feet
kg	=	kilograms
mg	=	milligrams
L	=	litre
ppm	=	parts per million
gal	=	gallons
L.	=	(when followed by a number) L.1.0 = less than 1.0
DEW	=	Distant Early Warning
POL	=	Petroleum, Oil and Lubricants
PCB	=	Polychlorinated Biphenyl
PCB/TCB	=	Polychlorinated Biphenyl/Tetrachlorobenzene mixture
EC	=	Environment Canada
EP	=	Environmental Protection
DIAND	=	Department of Indian Affairs and Northern Development
DND	=	Department of National Defence

1.0 Introduction

The original Canadian DEW Line system built in 1957 consisted of 42 sites across Canada's Arctic from the Alaska/Yukon border to the east side of Baffin Island (FIGURE 1). There were three distinct types of installations: main, auxiliary and intermediate. A main site (FIGURE 2) consisted of five 30-ft, two 60-ft, and two 120-ft parabolic antennae, one 25-ft UHF tower, a rotating radar, two building trains of up to 25 modules each, four 250,000-gal. POL tanks, five warehouses, a recreation building and several garage/storage buildings. An auxiliary site (FIGURE 3) consisted of several antennae, a rotating radar, one 25-module building train, one garage, one warehouse and four 65,000-gal. POL tanks. An intermediate site (FIGURE 4) consisted of a single five-module building train, one warehouse, one garage, one Inuit house, one Doppler Tower and, usually, four 20,000-gal. POL tanks (Andzan, 1984).

Of the 22 sites included in the 1985 clean-up, one was an auxiliary site, 20 were intermediate sites and one was a U.S. Coast Guard site. The U.S. Coast Guard site bore no resemblence to the DEW Line sites. It consisted of seven buildings: an incinerator building, boiler building, quonset huts and out-buildings.

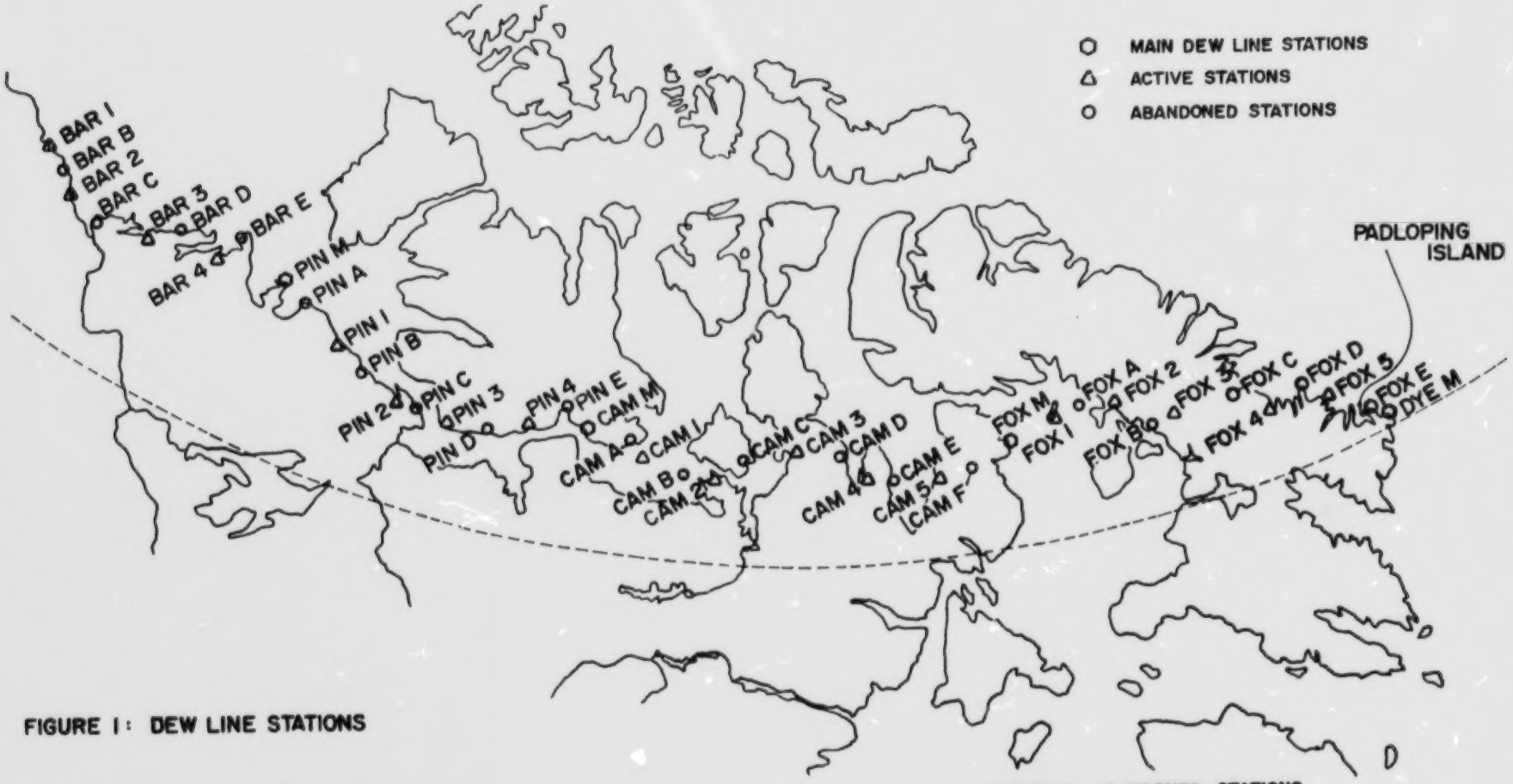


FIGURE 1: DEW LINE STATIONS

CANADIAN ACTIVE STATIONS

BAR 1	KOMAKUK BEACH
BAR 2	SHINGLE POINT
BAR 3	TUKTOYAKTUK
BAR 4	NICHOLSON PENINSULA
PIN M	CAPE PERRY
PIN 1	CLIFTON POINT
PIN 2	CAPE YOUNG
PIN 3	LADY FRANKLIN
PIN 4	BYRON BAY
CAM M	CAMBRIDGE BAY
CAM 1	JENNY LIND ISLAND
CAM 2	GLADMAN POINT
CAM 3	SHEPARD BAY
CAM 4	PELLY BAY
CAM 5	MACKAR INLET
FOX M	HALL BEACH
FOX 2	LONGSTAFF BLUFF
FOX 3	DEWAR LAKES
FOX 4	CAPE HOOPER
FOX 5	BROUGHTON ISLAND
DYE M	CAPE DYER

CANADIAN ABANDONED STATIONS

BAR B	STOKES POINT
BAR C	TUNUNUK
BAR D	ATKINSON POINT
BAR E	HORTON RIVER
PIN A	PEARCE POINT
PIN B	CLIFTON POINT
PIN C	BERNARD HARBOUR
PIN D	ROSS POINT
PIN E	CAPE PEEL
CAM A	STURT POINT
CAM B	HAT ISLAND
CAM C	MATHESON POINT
CAM D	SIMPSON LAKE
CAM E	KEITH BAY
CAM F	SARCPA LAKE
FOX 1	ROWLEY ISLAND
FOX A	BRAY ISLAND
FOX B	WEST BAFFIN
FOX C	EKALUGAD FJORD
FOX D	KIVITOO
FOX E	DURBAN ISLAND

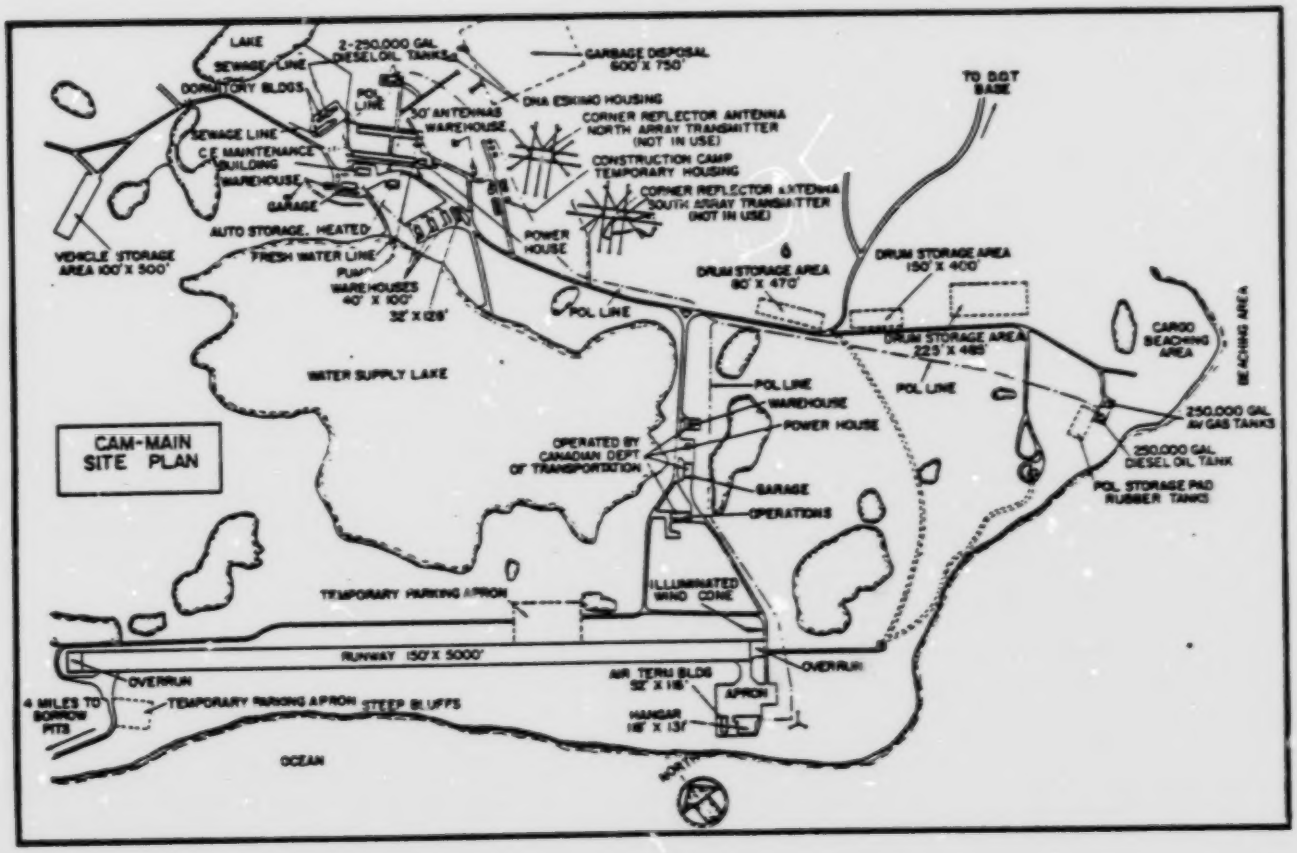


FIGURE 2: SITE PLAN OF A MAIN SITE

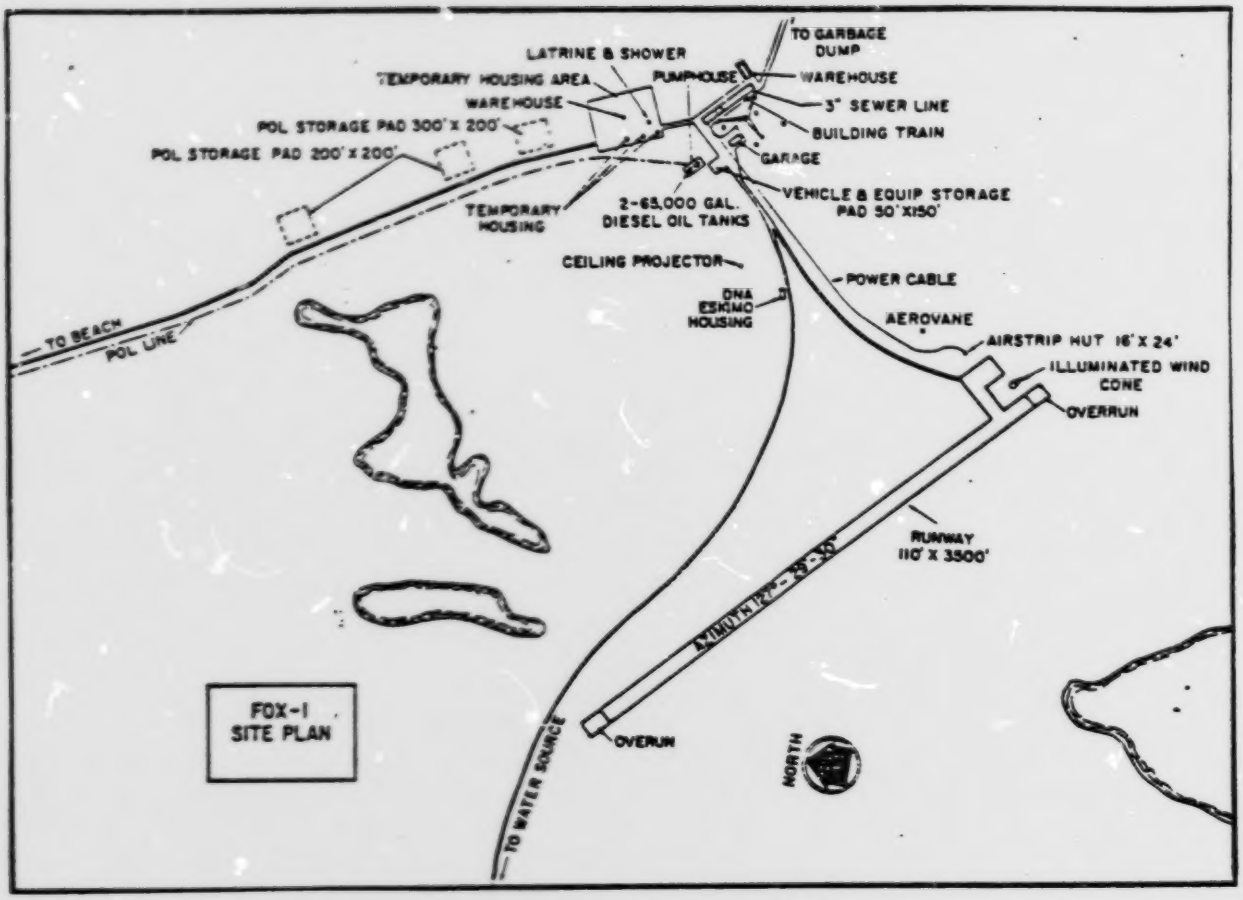


FIGURE 3: SITE PLAN OF AN AUXILIARY SITE

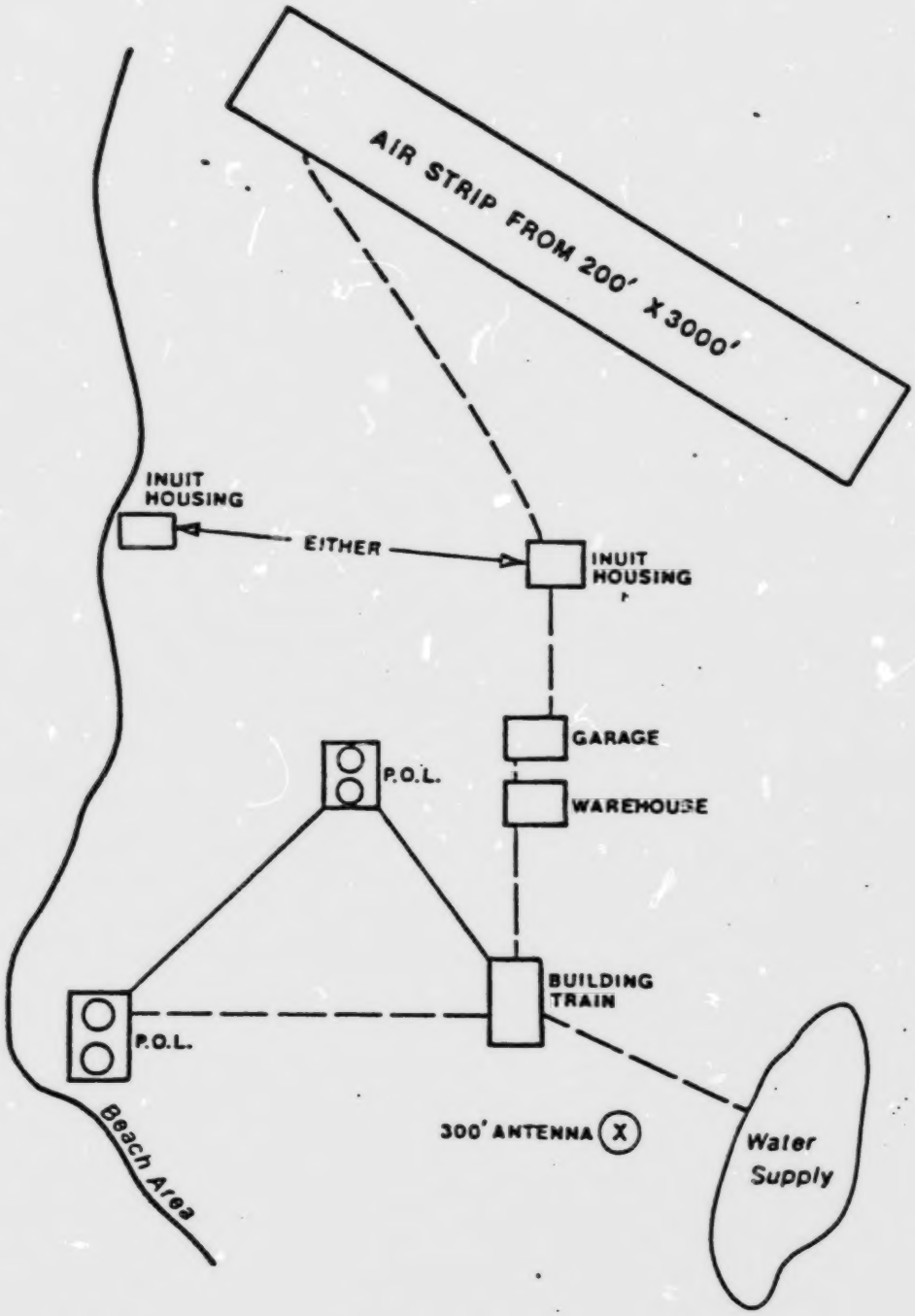


FIGURE 4: SITE PLAN OF AN INTERMEDIATE SITE

1.1 Waste Materials at DEW Line Sites

Based on information obtained from USAF records (Andzan, 1984), a list of waste materials which could have remained at the sites was made (Table 1).

TABLE 1

Potential Waste Materials at DEW Line Sites

*waste oil
*PCB transformers/capacitors
*asbestos
sewage
lead-based paints
*radioactive tubes
scrap metal
radar components
*fuel drums
lime
antifreeze
wood
*AVGAS (aviation fuel)
*sulfamic acid
cathode-ray tubes and screens
filtron tubes
oscillators
meters
copper wire
transmission fluid
*1-1-1-trichloroethane
PBX telephone equipment
*mercury vapour rectifier tubes
*paint thinners
*batteries
*chlorinated hydrocarbons
*corrosion inhibitors
*lye
*corrosives
paper
plastics
*solvent
*dynamite
*RF interference filters
generators
scopes
vehicles
rubber fuel bladders

*considered as hazardous material or containing hazardous materials

The purpose of the DEW Line clean-up was to remove surface contaminants from the abandoned sites to minimize the hazard to the environment and to people frequenting the sites. PCB-containing equipment in addition to abandoned fuel, lubricating oil, varsol and aviation fuel were previously identified as potential sources of contaminants (Holtz and Sharpe, 1984).

PCBs have had a variety of uses over the past 50 to 60 years. They have been used in hydraulic and heat transfer fluids, surface coatings for carbonless paper, washable wall coverings, upholstery fabrics, plasticizers in sealants, caulking and rubber and as flame retardants in lubricating oils (EPS, 1982). All of these may have been used on the DEW Line during its operation in the 1950s. However, the major use of PCBs was as a heat transfer/dielectric fluid in capacitors and transformers.

1.2 Background

The first confirmation that some of these materials were indeed present resulted from an inspection of Fox Sector (Hall Beach to Cape Dyer) DEW Line facilities carried out in 1981 (EP, 1981). PCB equipment was identified and inventoried as to location, type, size and condition. POL tanks at some sites still retained their original contents and stockpiles of fuels, solvents and lubricating oils existed. In addition, the sites were often strewn with metal and wood debris.

A complete inventory of PCB equipment at all active DEW Line facilities was reported to EP by DND in 1981, and in 1982/83, a clean-up program was initiated by the United States Air Command to remove this material. Concurrently, EP initiated a program to identify hazardous materials at all the abandoned sites by including them in a contracted review of active and abandoned landfills in the Northwest Territories (UMA, 1982). This review, however, did not involve actual on-site visits.

Consequently, in July 1984, EP surveyed five abandoned DEW Line sites in the central Arctic. These were all within 400 km of Cambridge Bay and included Hat Island (CAM B), Sturt Point (CAM A), Cape Peel (PIN E), Ross Point (PIN D) and Bernard Harbour (PIN C). Objectives of the investigation were: to inventory and report environmental conditions at the sites; to determine the extent of environmental problems; and to provide a basis for recommendations for future action regarding the 22 abandoned sites (Holtz and Sharpe, 1984).

The investigations revealed that one site had all buildings intact, while two of the sites had intact building trains, with only the foundations of the warehouse and garage remaining. The last two sites had only building foundations remaining. At the three sites where the building trains were still standing, four large cabinets containing PCB-filled electrical equipment were found in the communication rooms. At four sites, small capacitors were found on the ground outside the buildings. While much of the equipment seemed to be undisturbed and in good condition, the capacitors on the ground were corroded and leaking. Analysis revealed that these capacitors contained the PCB compound Aroclor 1254 (84% pure) and that the surrounding few inches of soil were contaminated. The buildings also contained generators and fluorescent light ballasts (PCB-containing), along with other debris.

Each site having intact buildings and electrical cabinets was estimated to have 1500 kg of equipment containing a total of 305 L of PCB fluid. Extrapolating these figures to include all 22 abandoned sites yielded a maximum estimate of 33,000 kg of equipment and 6700 L of PCB fluid. At those sites that were not intact, the PCB-containing equipment possibly had been scattered with the debris, buried or salvaged by the armed forces or scavenged.

Radioactivity detectors were used in the investigation, but no radioactive materials of any kind were detected or observed.

Observations at the five sites confirmed the presence of the following other wastes: building debris, empty or partially-filled drums of diesel fuel and lubricating oils and solvents, some of which were leaking. There was evidence at two sites of recent use by hunters and/or fishermen, and evidence of site use by numerous wildlife species - caribou, hawks, falcons, geese, swans and sandhill cranes.

A further six sites in the western Arctic were investigated in September 1984. These investigations produced similar information to that obtained in the first survey.

Based on this confirmation of the presence of significant quantities of hazardous materials, particularly PCB-containing electrical equipment, EP recommended that the federal government conduct a clean-up of all abandoned DEW Line sites. A national committee consisting of representatives from the Department of Indian Affairs and Northern Development (DIAND), the Department of National Defence (DND) and Environment Canada (EC) were assigned the following responsibilities for clean-up activities:

(a) DIAND to lead and coordinate community liaison work;
(b) DND to plan logistics, supply personnel and materials, and oversee the clean-up and removal of hazardous materials;
(c) EC to provide clean-up procedures, training in handling and safety procedures for the clean-up crews, on-site advice during clean-up, and supervision of equipment removal.

This report will present the methods used during the clean-up operation, summarize the on-site findings and make recommendations for further action.

2.0 Methods

2.1 1985 Clean-up Operation Methods

The clean-up operation at the 22 abandoned stations was scheduled for the period of 17 July to 10 September 1985. Two clean-up crews were formed to conduct the operation, one starting in the western Arctic at Inuvik and one in the eastern Arctic at Cape Dyer. Each clean-up crew consisted of seven military personnel, one Environment Canada representative, and one DIAND representative. A second Environment Canada representative and a National Research Council (NCR) advisor assisted both work crews in establishing clean-up procedures. Each crew was supported by two Twin Huey helicopters and a Buffalo aircraft supplied by DND.

A training session preceded crew movements to the eastern and western Arctic. Personnel were briefed on the properties and control of PCBs, safe handling of PCB-containing equipment, spill contingency plans, anticipated site conditions, and types and quantities of material expected. Each clean-up crew was provided with site maps and complete written procedures.

A reconnaissance of each site, by the crew commander and advisors, was conducted prior to crew deployment to establish on-site procedures and determine equipment needed for the removal of hazardous materials. Upon arrival at each site, the crew, walking at 10-pace intervals, swept the site, marking with stakes the points where equipment, barrels, suspect spills or burial sites were present. These were also marked on the site map (Figure 5).

The military crew proceeded to remove and package easily-identified PCB-containing equipment from the buildings (Figure 6). The

FIGURE 5: SITE SWEEP BY CREW

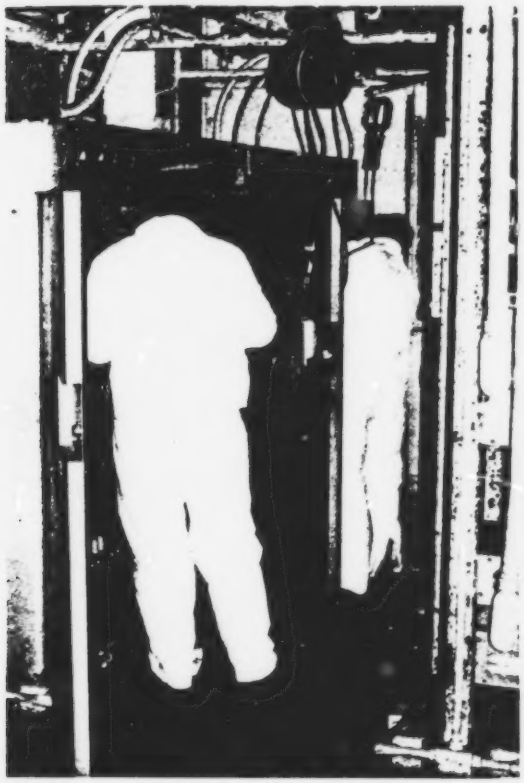


FIGURE 6: EQUIPMENT REMOVAL FROM BUILDINGS

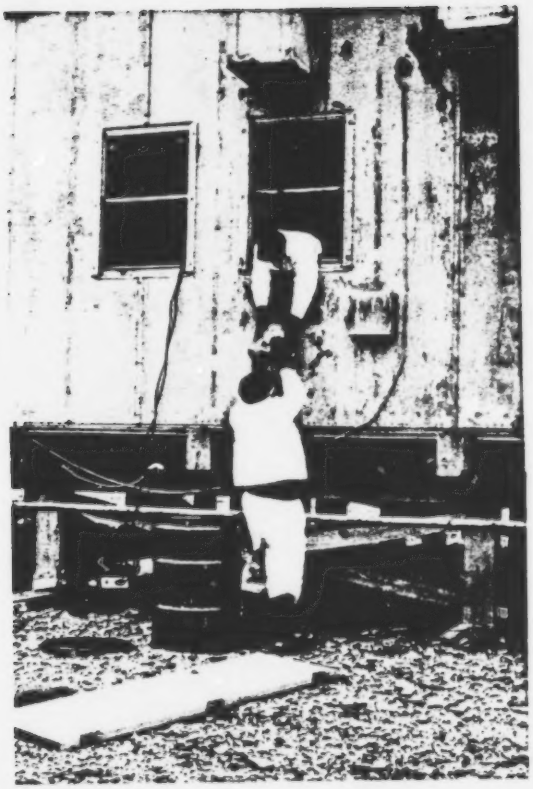
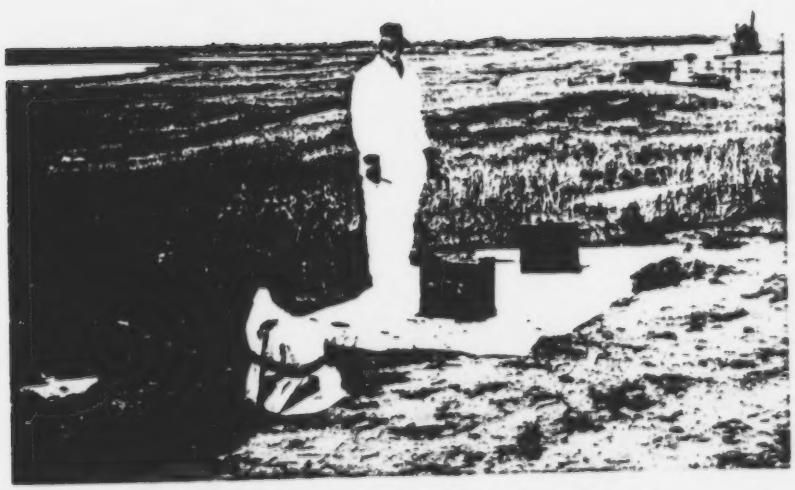


FIGURE 6: EQUIPMENT REMOVAL FROM BUILDINGS



equipment was inventoried, wrapped in heavy plastic (6 mil), placed in 45-gal. drums containing 5-7 cm of absorbent material and sealed (Figure 7). Loose equipment found outside buildings was treated similarly (Figure 8), while equipment too large to be accommodated in a drum was wrapped in plastic and placed on absorbent material in an Enviropac container (Figure 9). The Enviropac is a commercially-available, palletized, 16-gauge steel, sealable container, recommended for secondary containment of hazardous materials by the United States Environmental Protection Agency. Where the equipment content could not always be confirmed as PCBs, the equipment was removed and handled as if confirmation had been made. Each drum was marked with a serialized EP Hazard Warning Label, and placed with three other drums in an Enviropac container which was marked with PCB warning labels (Figures 10 and 11).

The DND Crew Commander and the EP, DIAND and NRC representatives proceeded with detailed site inventory and soil sample collection and testing at suspect spill and burial sites (Figure 12).

Soils were tested on-site for PCB presence, either using a field test kit or by odour (PCB/TCB mixtures can be detected by smell at 1-5 ppm). The field test kit used was developed for EP by Enviro-Test Laboratories and was based on thin layer chromatography of extracted organo-chlorine compounds with a detection limit of approximately 10 ppm (Envirotest, 1985).

Soil PCB levels were recorded on site maps, while the visibly stained area was marked with paint. Soil was then removed to about 7 cm beyond the outline, and to a depth of approximately 30 cm (Figure 12). Further testing was conducted and more soil removed as necessary. The contaminated soil was placed in 45-gal. drums and then into Enviropacs, while clean gravel from elsewhere on the site was used to fill the hole.

FIGURE 7: IDENTIFICATION AND REMOVAL OF EQUIPMENT OUTDOORS

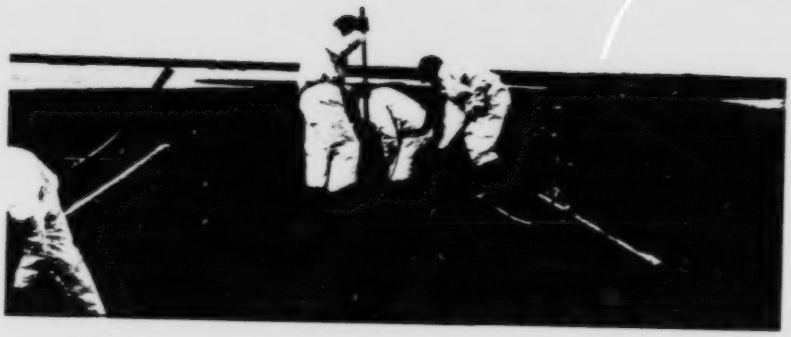
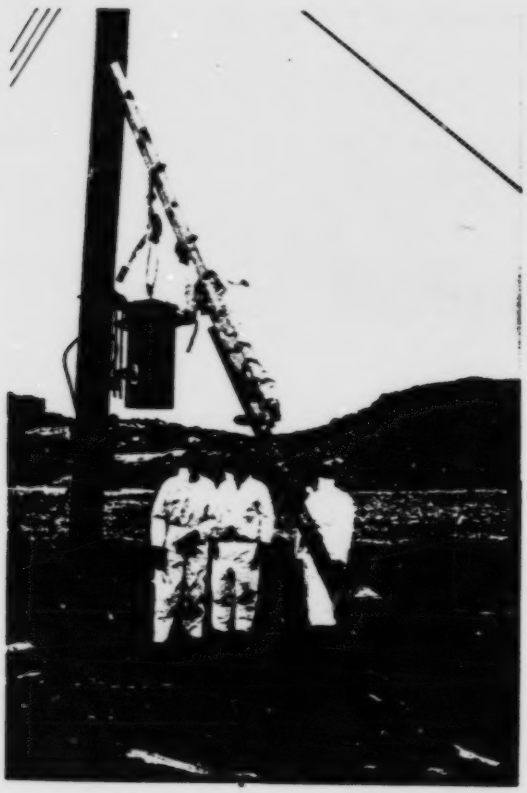


FIGURE 8: SOIL AND EQUIPMENT CLEAN-UP



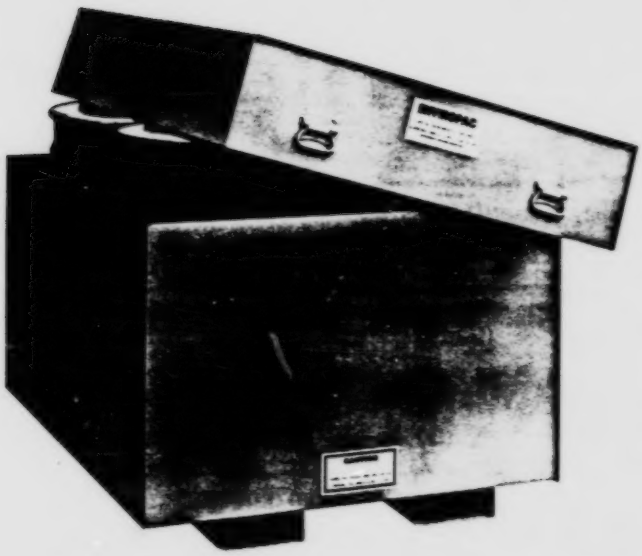


FIGURE 9: ENVIROPAC CONTAINER USED TO MOVE/STORE DRUMS

FIGURE 10: BARRELED EQUIPMENT REMOVAL

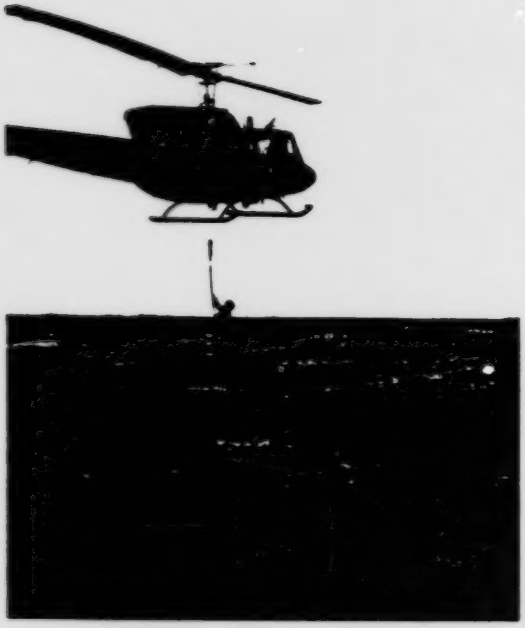


FIGURE 11: LOADING BARRELS

Confirmatory soil samples were taken using a sterile tongue depressor as a scoop, stored in aluminum foil and placed in plastic bags for subsequent gas chromatographic (G.C.) analysis at the EP laboratory in Edmonton. Samples were also taken at sites where it was suspected that PCB-containing equipment was buried.

Concurrently, designated military personnel conducted the inventory and destruction of POL (Figure 12). Clean-up of non-hazardous waste and debris remaining at the sites may be conducted in the future by DIAND in cooperation with the Government of the Northwest Territories.

Filled drums and Enviropacs were flown back to the nearest auxiliary or main DEW site each day for interim storage until the containers were consolidated at Hall Beach (Figure 13). From September to April, all filled containers were transported by air to the United States by U.S. military personnel for ultimate disposal.

2.2 Laboratory Methods

Eighty-nine soil and two oil samples were received at the EC laboratory in Edmonton 24 October 1985 from both DEW Line clean-up crews. Analysis of samples began in early November.

2.2.1 Sample Preservation and Preparation

Samples were stored at 2°C until the start of analysis. Then they were removed from the aluminum foil wrapping and set on aluminum plates for drying in a 30°C drying room. Upon completion of the drying step, the samples were filtered through a 2 mm sieve. After sieving, the portions were stored in glass bottles capped with aluminum foil.

FIGURE 12: SOIL SAMPLING AND POL DESTRUCTION

FIGURE 13: LOADING ENVIROPACS INTO THE BUFFALO

The 2 mm portion was then extracted, employing standard PCB methodology (ASTM) for PCBs in soil samples. The extract was then stored in a 15 ml vial for subsequent analysis on the G.C.

2.2.2 G.C. Analysis

A Hewlett Packard 5830A gas chromatograph (G.C.) equipped with a Ni63 electron capture detector and DB-I column was used for PCB analyses.

A Varian 6000 G.C. with a similar detector was also employed for verification of results.

2.2.3 Quality Control

Selected samples were spiked with a known amount of AROCLOR 1254 and 1016. The recovery of AROCLOR 1254 and 1016 was satisfactory in all cases. In sample #5, the spike was masked by the large concentration of PCB in the sample. The results from this work can be found in Appendix B.

3.0 Results

3.1 Site Evaluation

3.1.1 Stokes Point - BAR B

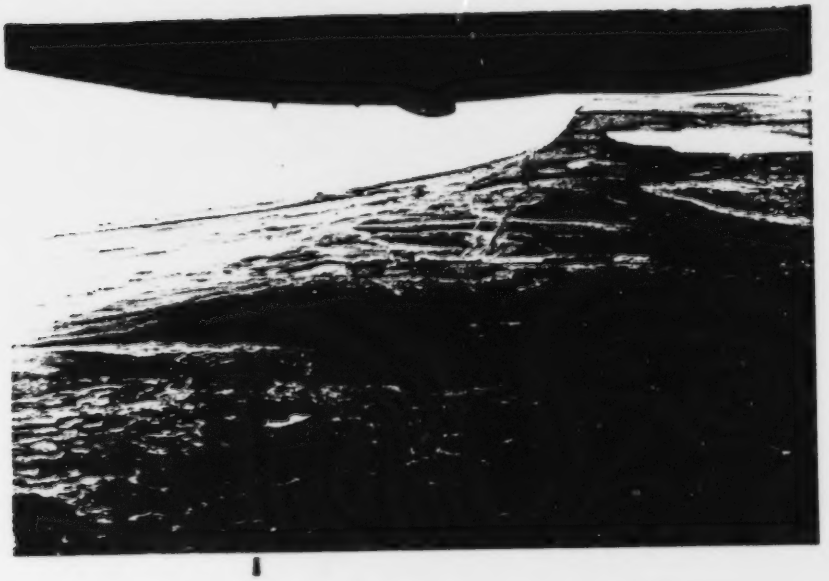
The abandoned DEW Line station, located 220 km west of Tuktoyaktuk on the mainland at Mackenzie Bay, lies 1 km inland on the coastal plain on a 30 m elevated beach ridge. Permafrost and extensive areas of organic deposits, frost polygons, tundra cliffs, recurved beach ridges and thermakarst lakes dominated the area. Vegetation consisted of dwarf willow, sedges, grasses and moss (Figure 14).

At the building site (Figure 15), the garage, warehouse foundation, radio tower (new) and POL tanks remained. No PCB-containing equipment was found except for one light ballast. Pieces of broken wood and metal were observed along the west edge of the building site, protruding through the gravel and signifying the possible location of the building train and warehouse remnants (Figure 15).

No evidence of electrical equipment or groundwater drainage from the suspected burial site was found. A soil sample taken for analysis on the site revealed no PCBs (Appendix A).

The beach POL tanks were partially full. One tank contained an estimated 42,000 L of diesel fuel and the other contained 21,000 L. The mainsite POL tanks were empty. Seventeen drums of lubricating oil were found. These were not burned or moved because of the ice-laden soil, the thick layer of dry grasses/ sedges and the rusty condition of the barrels.

FIGURE 14: SITE OVERVIEW - STOKES POINT



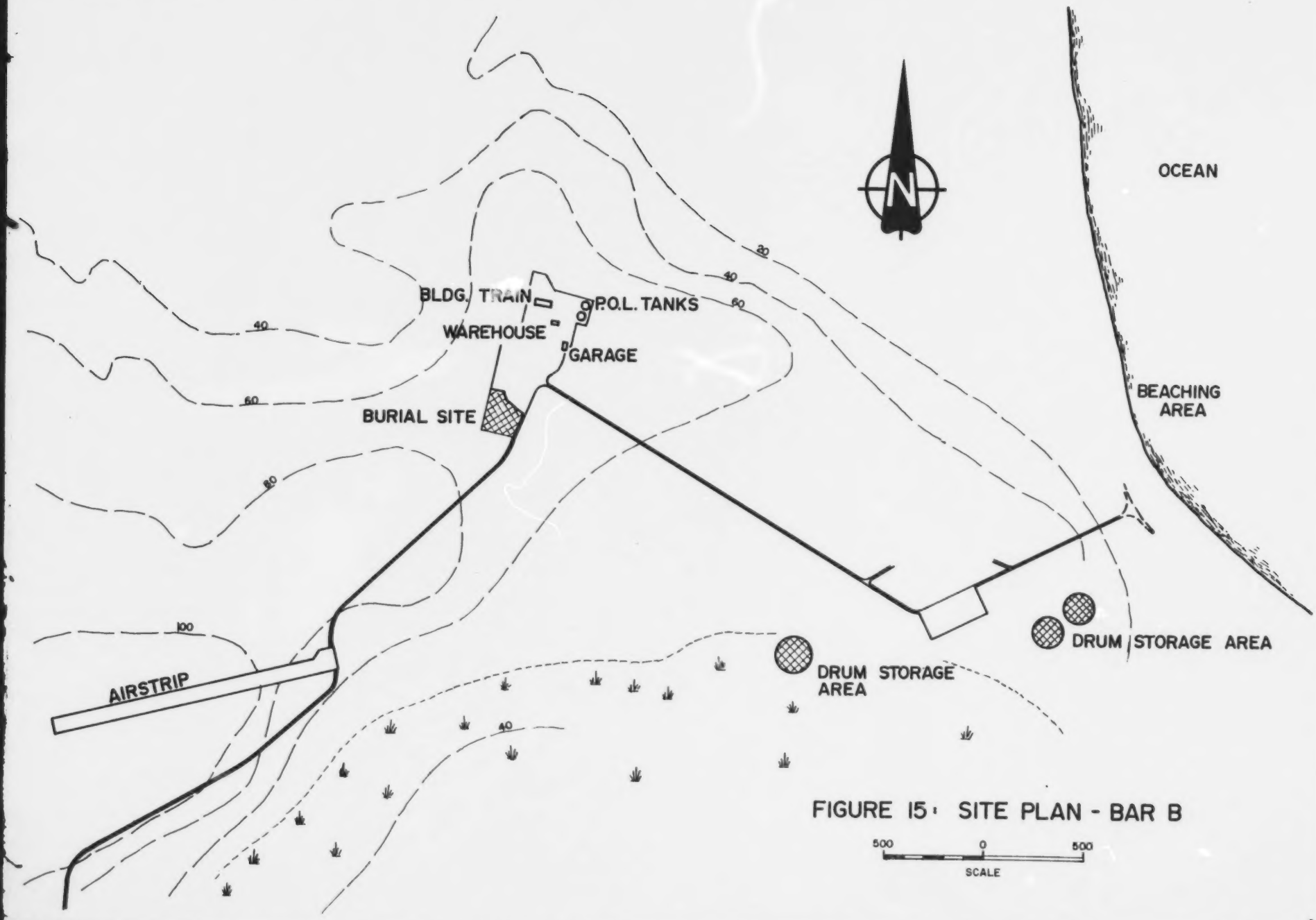


FIGURE 15: SITE PLAN - BAR B

3.1.2 Tununuk - BAR C

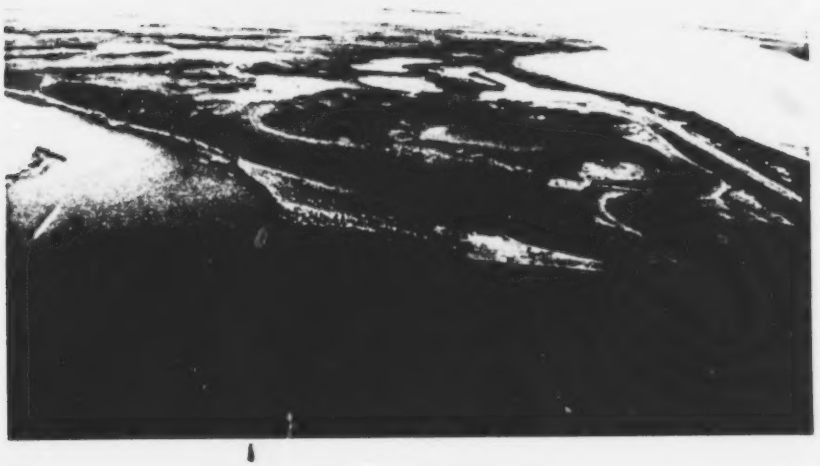
Tununuk, located 75 km southwest of Tuktoyaktuk on Richardson Island in the Mackenzie Delta, lies 2 km inland on a 50 m high plateau. The low relief terrain was characterized by hummocky moraine deposits, low relief, numerous lakes and pingos. The soil consisted of frost fractured sandstone with mixed gravel and fine sand. The vegetation consisted of willow mixed with over-topping aspen; grasses and sedges dominated the undergrowth or groundcover in open spaces (Figure 16).

The building site was empty except for the powerhouse of the building train. Portions of the building train had been dismantled and moved to Tuktoyaktuk several years ago. The warehouse, garage and NAR house had been moved to the Esso Resources site 1 km to the west (Andzans, 1984). The garage remains on the Esso site; other buildings at the site were relatively new structures.

Two disposal areas were located, the first being at the south edge of the building site (Figure 17). This area was covered with gravel. Subsidence and building material were evident. A soil sample taken below the burial site (Table 2 - Sample 701) indicated levels of PCB residue at 10 ppm.

The second site was located behind the Esso Resources fuel tanks (Figure 17) in a tree-covered ravine. Several pieces of electrical equipment were removed from this site. Samples from the transformer and soil (Table 2) indicated the presence of low level contamination in the transformer, but no contamination of soil in the ravine could be found.

FIGURE 16: SITE OVERVIEW - TUNUNUK



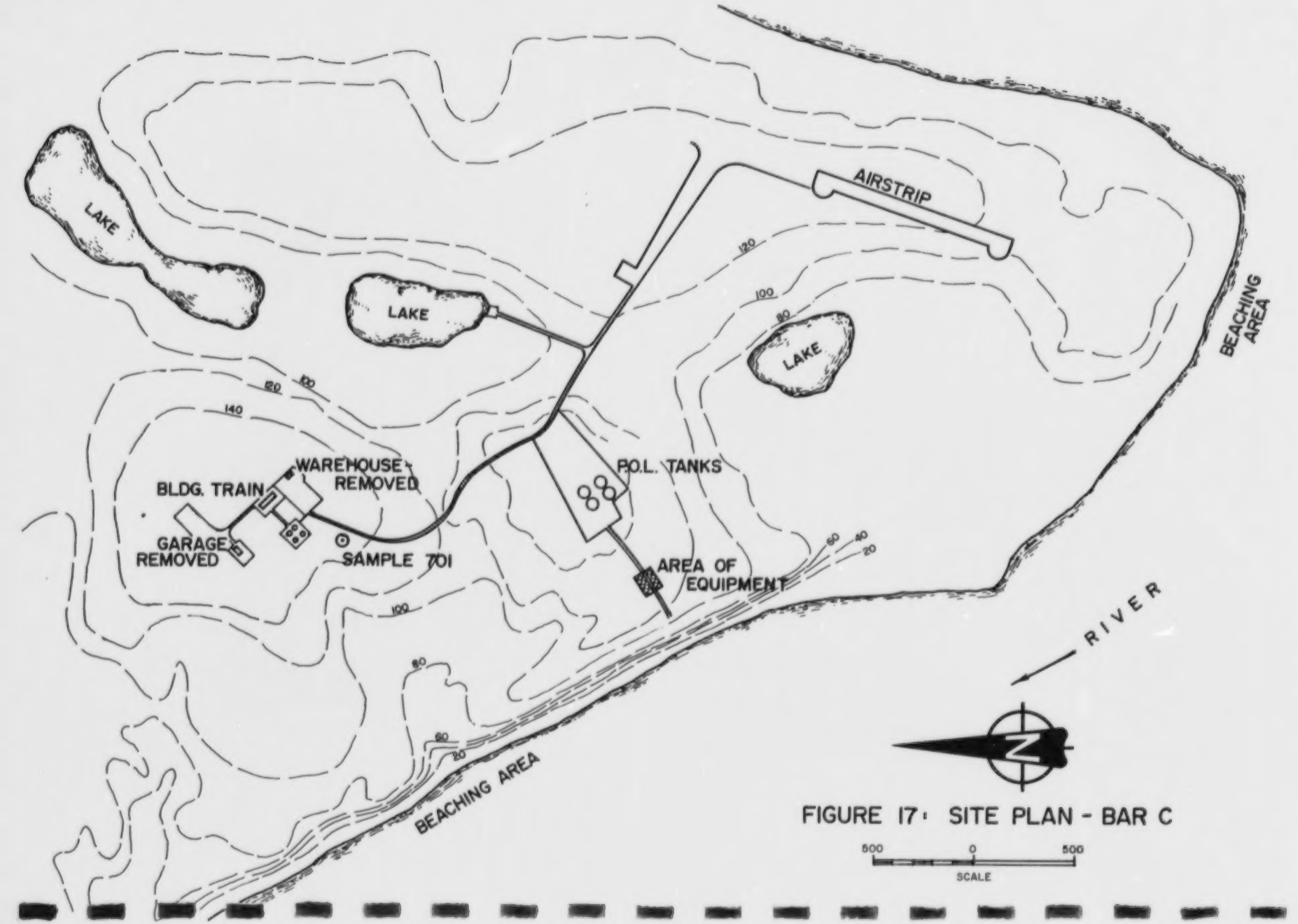


FIGURE 17: SITE PLAN - BAR C

Fuel and oil in several tanks and 117 drums were located and left untouched as they were not supplies normally associated with the DEW system.

The Tununuk site will require future evaluation. It has been identified for inclusion in the North Warning System and as a staging area for Beaufort Sea Development (Andzans, 1984).

Table 2 - PCB Residue Analysis - BAR C

Sample Number	Description	Aroclor	Amount (in ppm)
0698	Site 2		L. 1
0699	Site 4, ravine bottom		L. 1
0700	Soil from transformer	1254	4.1
0701	Site 1, building site	1254	10

3.1.3 Atkinson Point - BAR D

Atkinson Point, 80 km east of Tuktoyaktuk on the mainland at McKinley Bay, lies 1 km inland at an elevation of 3 m. The station was situated on a flat, marshy site near the shore of a large lake. The sand-dune soil on the coarse glaciofluvial plain was dominated with sedge and grass vegetation; the occasional stunted/ dwarf willow or herb was observed (Figure 18).

An active Reindeer Herding Station and Energy Mines and Resources, Polar Continental Shelf Decca Project operations centre exist on the site. The building train, warehouse and garage were in use and in good structural condition. Light ballasts were left in the building train and capacitors left in the garage. The remaining equipment was located in three dumpsites near the POL tanks (Figure 19).

Dump 1 contained most of the large pieces of electrical equipment. Some of it was punctured with bullet holes and had been leaking; the frozen soil limited the outflow of PCBs to the immediate vicinity of the equipment. Soil was removed until no odour of PCB/TCB persisted. Soil samples taken from the east and west sides indicated that no PCBs were released from this dump (Table 3).

Dump 2 contained the stripped communication cabinets. Dump 3 contained the swing-out electrical panels from the communication cabinets. Soil samples indicated that low levels of contamination were released from these two dumps (Table 3).

No drums of POL were found. The site tanks were empty, but the beach tanks contained 36,000 L to 45,000 L of diesel. These were left at the site operator's request.

FIGURE 18: SITE OVERVIEW - ATKINSON POINT

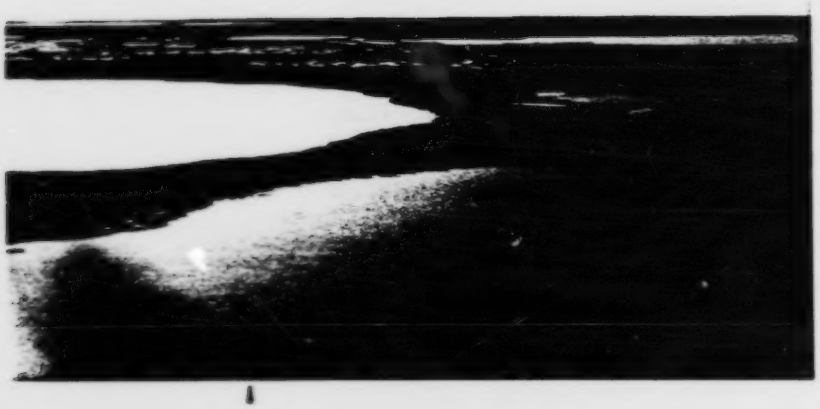


Table 3 - PCB Residue Analysis - BAR D

Sample Number	Description	Aroclor	Amount (in ppm)
0690	Dump 1 - west side		L. 1
0691	Dump 2 - west side		L. 1
0692	Dump 1 - east side		L. 1
0693	Dump 2 - S.W. corner	1254	200
0694	Dump 3 - west side	1254	26
0695	Background		L. 1

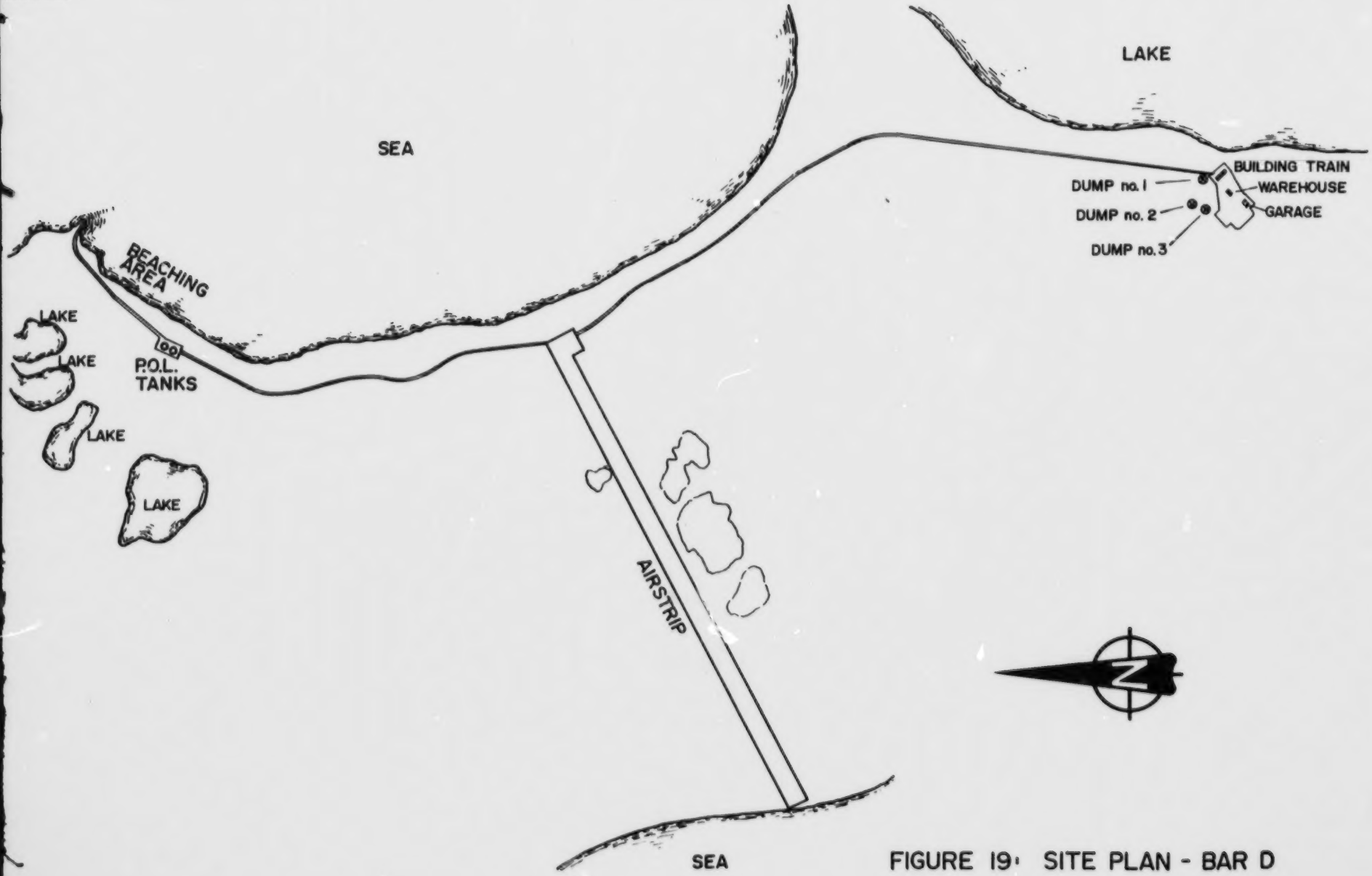


FIGURE 19: SITE PLAN - BAR D

3.1.4 Horton River - BAR E

The abandoned site lies 240 km east of Tuktoyaktuk on a 158 m high ridge called Malloch Hill. A steep cliff (100 m in height) separates the building site from Franklin Bay. The soil was composed of well-drained sandy silt mixed with fine to medium grained gravel. Permafrost could be found within 10 cm of the surface; thus, vegetation consisted of short grasses and sedges mixed with mosses and lichens. The tops of the ridges, and slopes in ravines, were mostly barren of vegetation (Figure 20).

The building site consisted of a building train, warehouse, garage, storage shed and an upright Doppler Tower. All the buildings were structurally sound, although the interiors were heavily vandalized. Electrical equipment, which had been removed from the communication cabinets, was found in the generator module and in a dumpsite beside the airstrip. All equipment, except for a few light fixtures and small capacitors, was accounted for and removed from the site.

There were six dumpsites found around the building site (Figure 21). Only one dump, at the airstrip, contained electrical equipment. One large transformer (burned and empty) and one medium-sized PCB-containing capacitor (leaking) were found in the dump. Samples from both indicated that the transformer was oil-filled with low level contamination and the capacitor contained high levels of PCBs (Table 4). Soil was removed from around the equipment, leaving the area relatively PCB-free.

All four POL tanks were empty. Out of the several hundred drums around the site, only four drums were found to contain aviation fuel and these were destroyed.

FIGURE 20: SITE OVERVIEW - HORTON RIVER

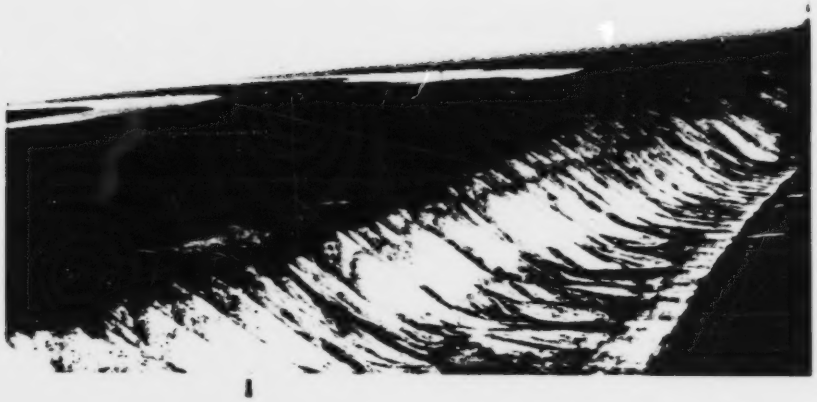


Table 4 - PCB Residue Analysis - BAR E

Sample Number	Description	Aroclor	Amount (in ppm)
0704	Dump 1, large transformer	1254	2.9
0705	Dump 1, capacitor	1254	120,000

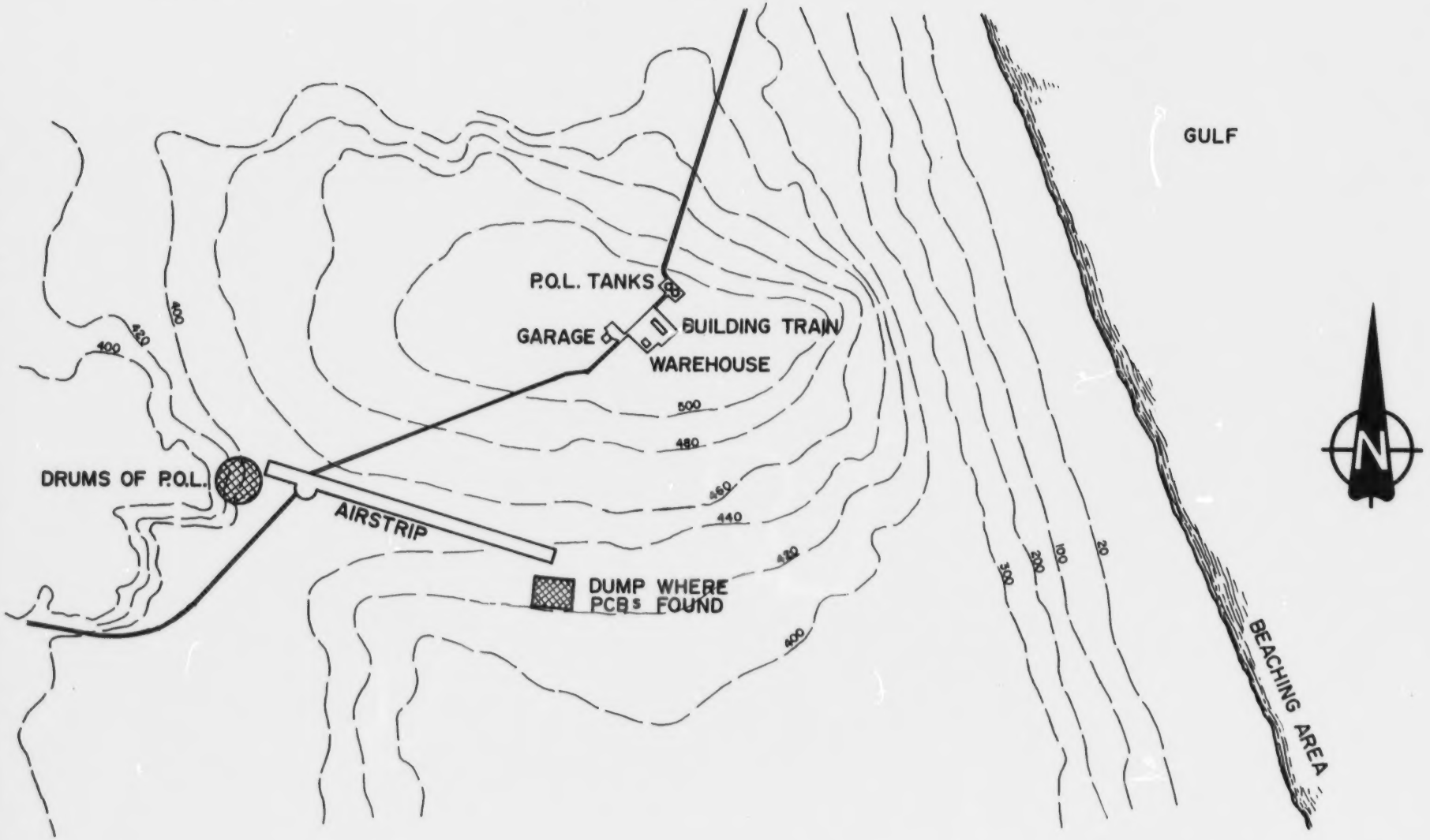


FIGURE 21: SITE PLAN - BAR E

500 0 500

SCALE

3.1.5 Pearce Point - PIN A

Pearce Point is located 320 km east of Tuktoyaktuk on the mainland at Darnley Bay. The building site lay on the east side of the Bay on a 48 m high rocky outcrop (Figure 22). The immediate area was rough and hilly, with decomposed limestone soil on a solid limestone base. Vegetation was sparse and consisted of small patches of moss.

The building site consisted of a building train, garage, warehouse, bunkhouse, aluminum-clad building and NAR house (Figure 23). All were in excellent structural condition.

Most heavy solid waste had been removed by students who were using the site as a Scientific Research Station. Most of the scrap metal had been placed in Darnley Bay some years ago. All PCB-containing equipment that was present was removed. Two mineral oil transformers were located, tested and left (Figure 23). No PCB residues were found (Appendix A). The two sets of POL tanks were empty. Several hundred empty drums were checked on the beaching area. A stack of 57 drums of lubricating oil was left when the oil would not ignite (Figure 23).

FIGURE 22: SITE OVERVIEW - PEARCE POINT

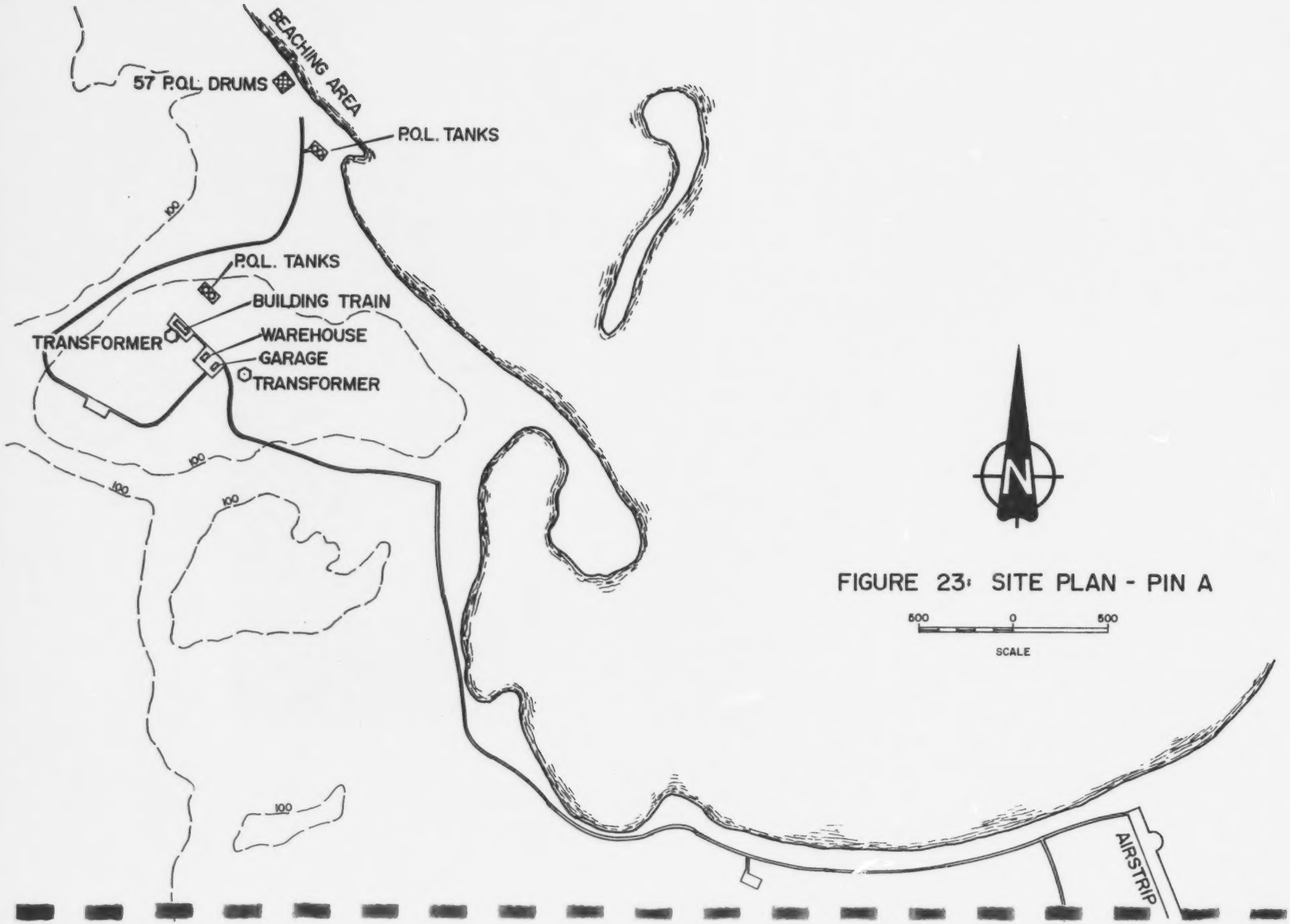


FIGURE 23: SITE PLAN - PIN A

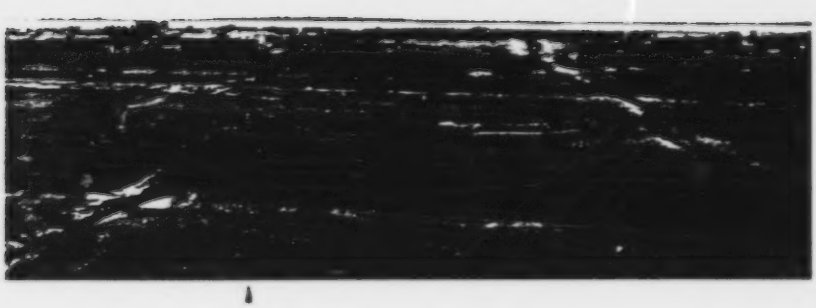
3.1.6 Clifton Point - PIN B

Clifton Point, 460 km east of Tuktoyaktuk, is situated 1 km inland of Amundsen Gulf on a 30 m high ridge between the Croker and Inman Rivers. Soil consisted of sand, gravel or, in places, a thin organic layer overlaying gravel. Vegetation consisted of scattered clumps, thin moss mats or sedge meadows in depressions (Figure 24).

All buildings were in good structural condition (Figure 25). All the PCB-containing equipment was accounted for and removed.

No PCB residues were found (Figure 25) (Appendix A). Roughly 2700 L of motor oil and kerosene were burned. No other POL was found on site.

FIGURE 24: SITE OVERVIEW - CLIFTON POINT



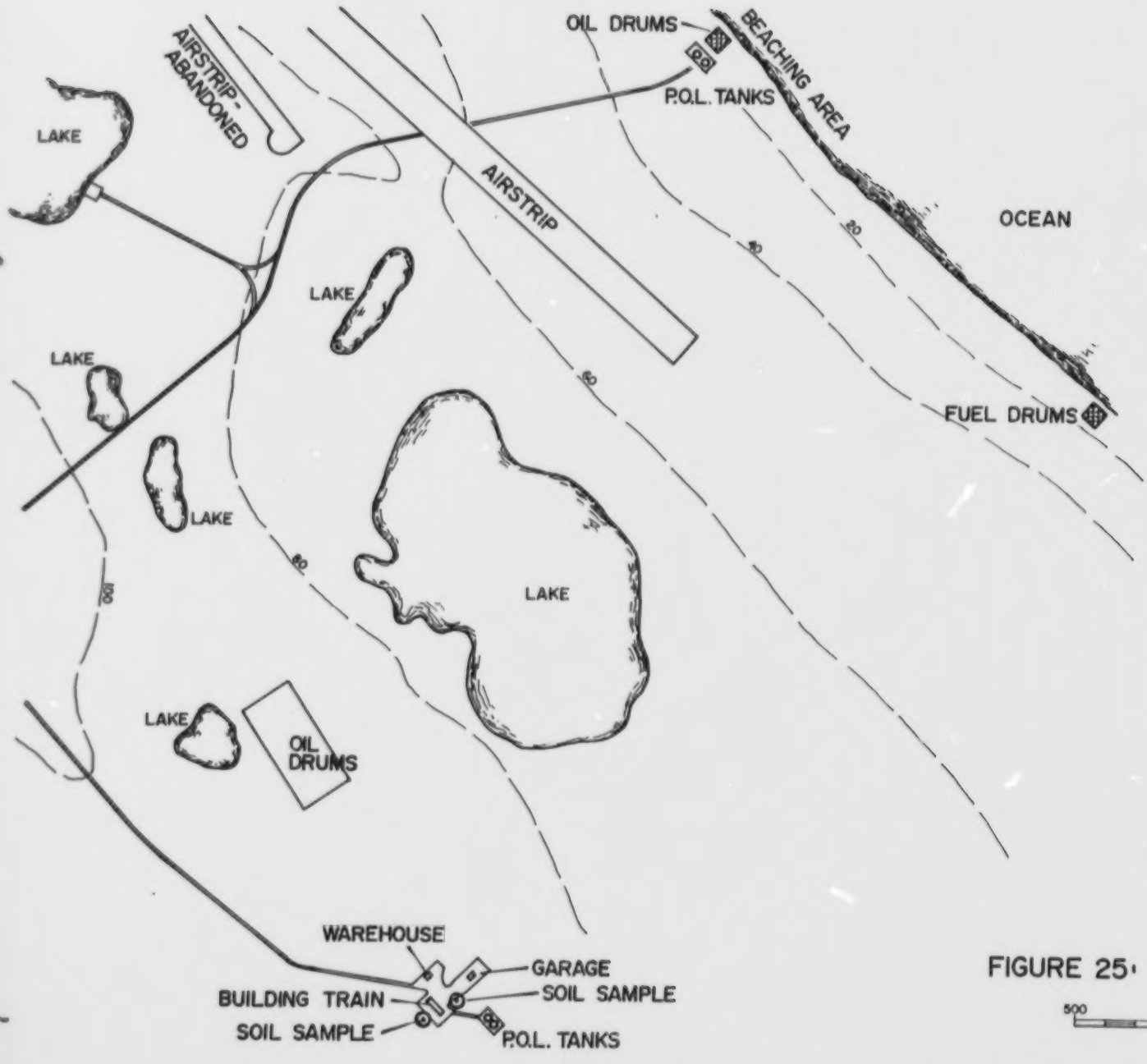


FIGURE 25: SITE PLAN - PIN B

3.1.7 Bernard Harbour - PIN C

The Bernard Harbour site, 400 km west of Cambridge Bay, lies 1 km inland on a 30 m high natural plateau in the Dolphin and Union Strait area. The site was located on typical coastal terrain dominated by marine and lacustrine deposits, including a series of raised sandy beaches (Figure 26). The vegetation consisted of extensive sedge meadows on the flat areas, with the sloped areas covered with grass hummocks and lichens.

All the structures were standing and structurally sound, but had been vandalized. Some of the electrical equipment had been removed from the buildings, but none was damaged. The majority of equipment was found and removed with the exception of ten de-icing capacitors and several small capacitors which were not located.

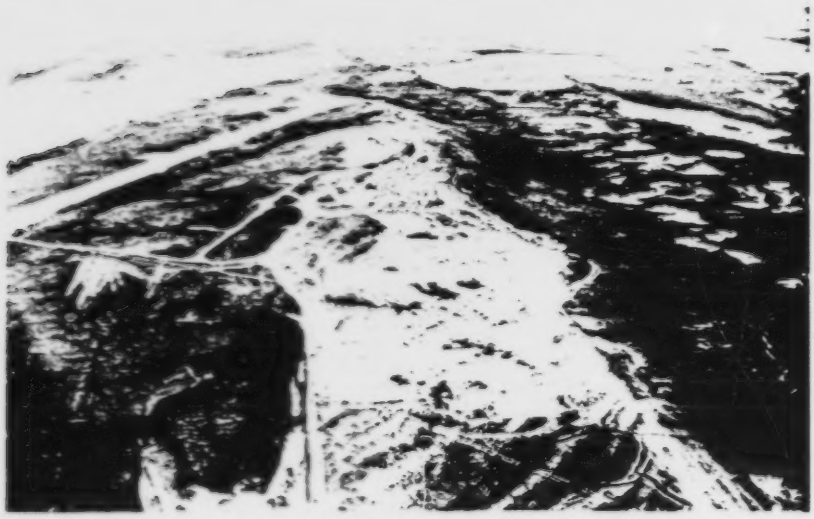
Soil samples (Figure 27) obtained from the base of the building train entrance indicated low level contamination on-site. (Table 5). A soil sample (background) taken away from the building site produced detectable levels of PCB residue.

The four POL tanks were missing. A cache of 10 drums of lubricants were found at the beaching area. Ignition was attempted, but as the crew left, no smoke was seen. It was assumed that the contents poured onto the gravel. Bad weather set in and the crew could not return. This spill should not cause environmental damage, as the area was far away from the influence of sea water or sea ice.

Table 5 - PCB Residue Analysis - PIN C

Sample Number	Description	Aroclor	Amount (in ppm)
0702	On-site soil sample	1254	11
0703	Background	1254	1.0

FIGURE 26: SITE OVERVIEW - BERNARD HARBOUR



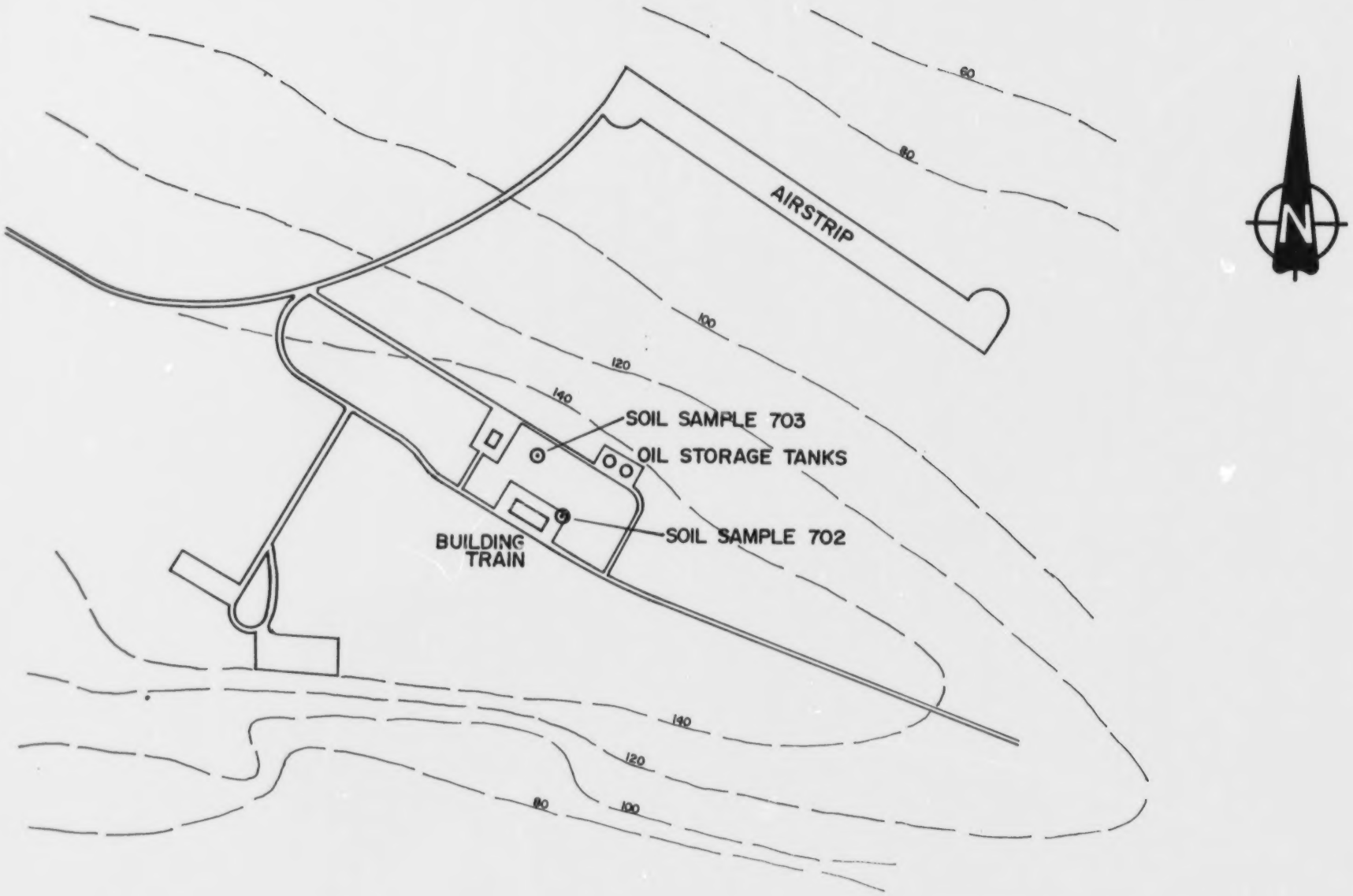


FIGURE 27: SITE PLAN - PIN C

300 0 300

SCALE

3.1.8 Ross Point - PIN D

This abandoned site is located 225 km west of Cambridge Bay on a 105 m high mesa overlooking Coronation Gulf. Soil was lacking on the dolomite bedrock outcrop of the building site. Flat valleys between glacial-till hills, lakes, tundra grasses, mosses and low lying wetlands characterized the surrounding area (Figure 28).

The building train and garage were the only buildings left. Vandalism was evident, with electrical equipment found inside the building train, and debris scattered around the warehouse and under the garag stairs. No equipment was found leaking. Most PCB- containing equipment was accounted for except de-icing motors and capacitors. A soil sample on-site resulted in no detectable PCB residue (Figure 29).

The POL tanks had been removed. One tank (400 L) supplying diesel to the warehouse was found to contain diesel fuel. This was drained into empty drums and burned (Figure 29). Several hundred empty drums were checked in three storage areas. No other POL was found.

FIGURE 28: SITE OVERVIEW - ROSS POINT

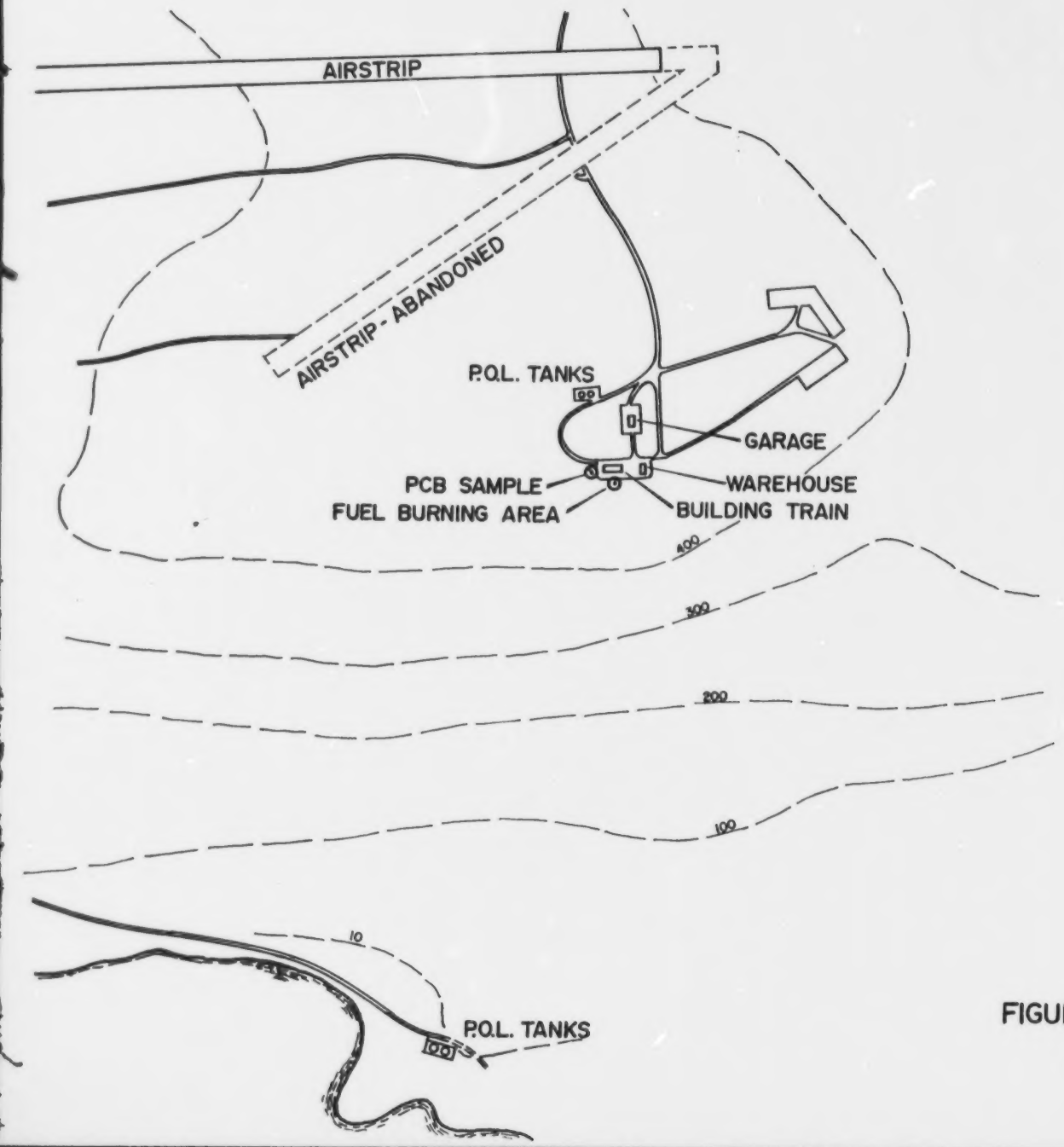


FIGURE 29: SITE PLAN - PIN D

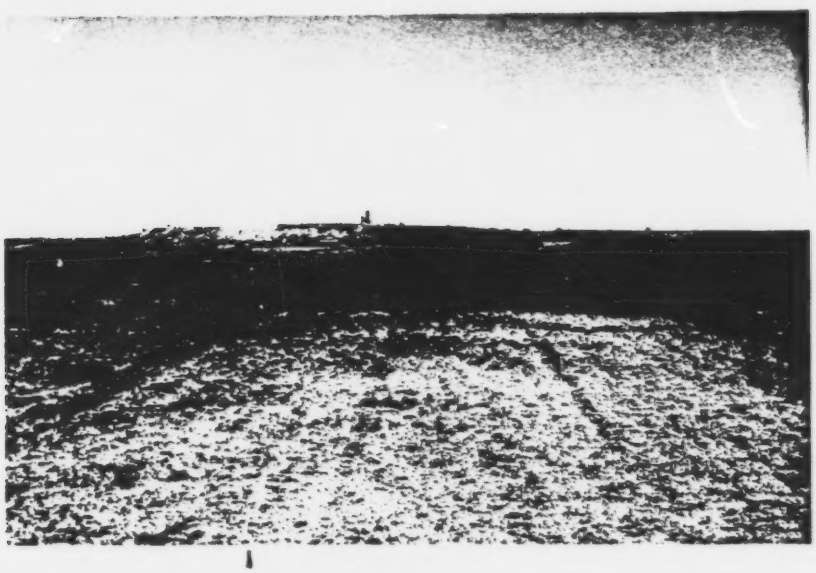
3.1.9 Cape Peel - PIN E

Cape Peel, 80 km west of Cambridge Bay, lies on a 41 m high raised beach 3 km inland from Dease Strait. There were two prominent raised beaches between the shoreline and the site. The site area consisted of sandy to coarse gravel over bedrock. Permafrost formations such as hummocky surface, ice-wedge polygons, nets and non-sorted circles were common. Vegetation consisted of sedges, arctic willow and mosses in hummocks (Figure 30).

Very little of the original structures remained on-site. The powerhouse module remnants and generators were northwest of the building site. Cement pads (heavily damaged) remained, marking the location of buildings (Figure 31). Only a portion of the electrical equipment was found on-site and in a dumpsite. One transformer, leaking, was located beside the powerhouse module. Sample analysis indicated that the transformer was oil-filled with low level PCB contamintion present (Table 6). Analysis after soil removal indicated that some low level PCB residue remained (Figure 31) (Table 6).

An on-site sample (Figure 31), taken from the original location of the communication module, indicated that this area contained significant levels of PCB residue (Table 6). In a dumpsite (Figure 31), a leaking capacitor with high PCB concentration was found and removed. Soil was removed from around the capacitor until PCB/TCB smell could not be detected. In spite of the clean-up effort, significant residual PCB levels remained. A sample taken between the dumpsite and the airstrip for background indicated that low level contamination existed in this area (Table 6) (Figure 31). These values could have resulted from past spills or from soil erosion from the main site.

FIGURE 30: SITE OVERVIEW - CAPE PEEL



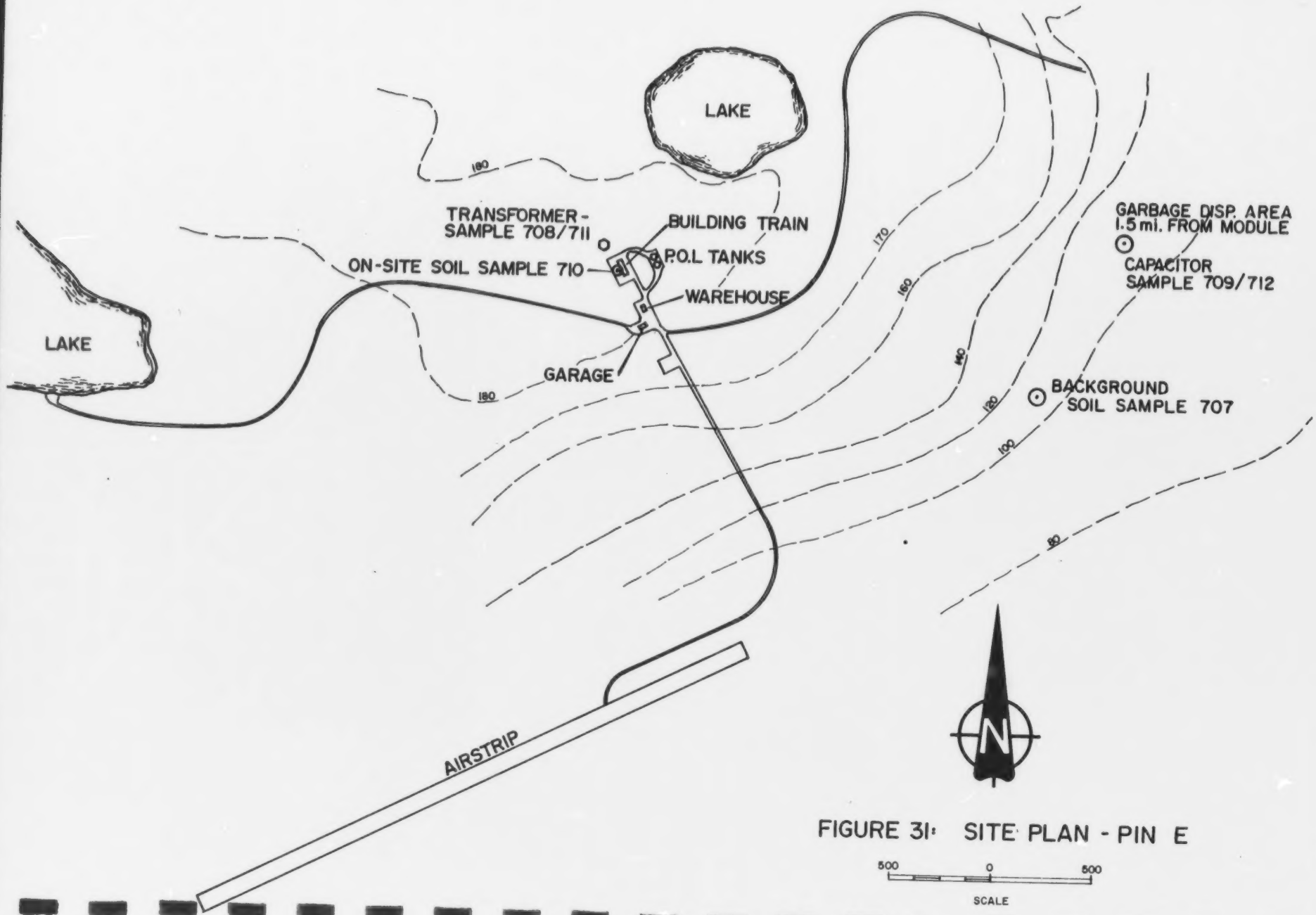


FIGURE 31: SITE PLAN - PIN E

Table 6 - PCB Residue Analysis - PIN E

Sample Number	Description	Aroclor	Amount (in ppm)
0707	Background	1254	6.2
0708	Soil under leaking transformer	1254	4.4
0709	Dump - under capacitor	1254	140,000
0710	On-site sample	1254	74
0711	After clean-up of leaking transformer	1254	2.4
0712	Dump - after clean-up	1254	720

3.1.10 Sturt Point - CAM A

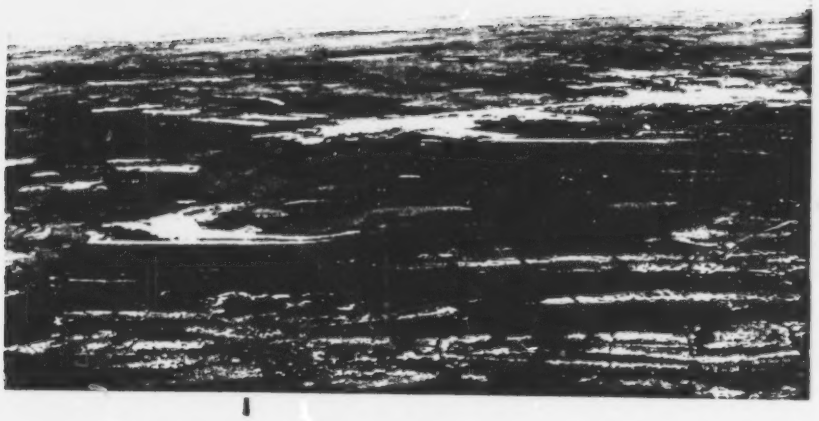
Sturt Point, 80 km east of Cambridge Bay at Parker Bay, lies 2 km inland on a low lying stretch of land. The area was mainly ice-pushed ridges from rebound after glacial compression (Figure 32). The soil was composed of sand and coarse gravel, with many permafrost features such as low center polygons, nets and non-sorted circles. Vegetation consisted of short grasses, herbs and moss.

The buildings had been demolished or removed, with the cement foundation pads remaining. Only the tank module of the building train remained, 300 m west of the building site. Two light ballasts were removed from the module. A small transformer, shot full of holes, was found at the base of the warehouse foundation (Figure 33). Soil analysis indicated that the transformer contained low levels of PCB residue (Table 7). Soil samples from other locations indicated that the area was not contaminated.

Table 7 - PCB Residue Analysis - CAM A

Sample Number	Description	Aroclor	Amount (in ppm)
0719	Below Dump		L.1
0720	Around transformer	1254	11
0721	On-site sample		L.1
0722	Background		L.1

FIGURE 32: SITE OVERVIEW - STURT POINT



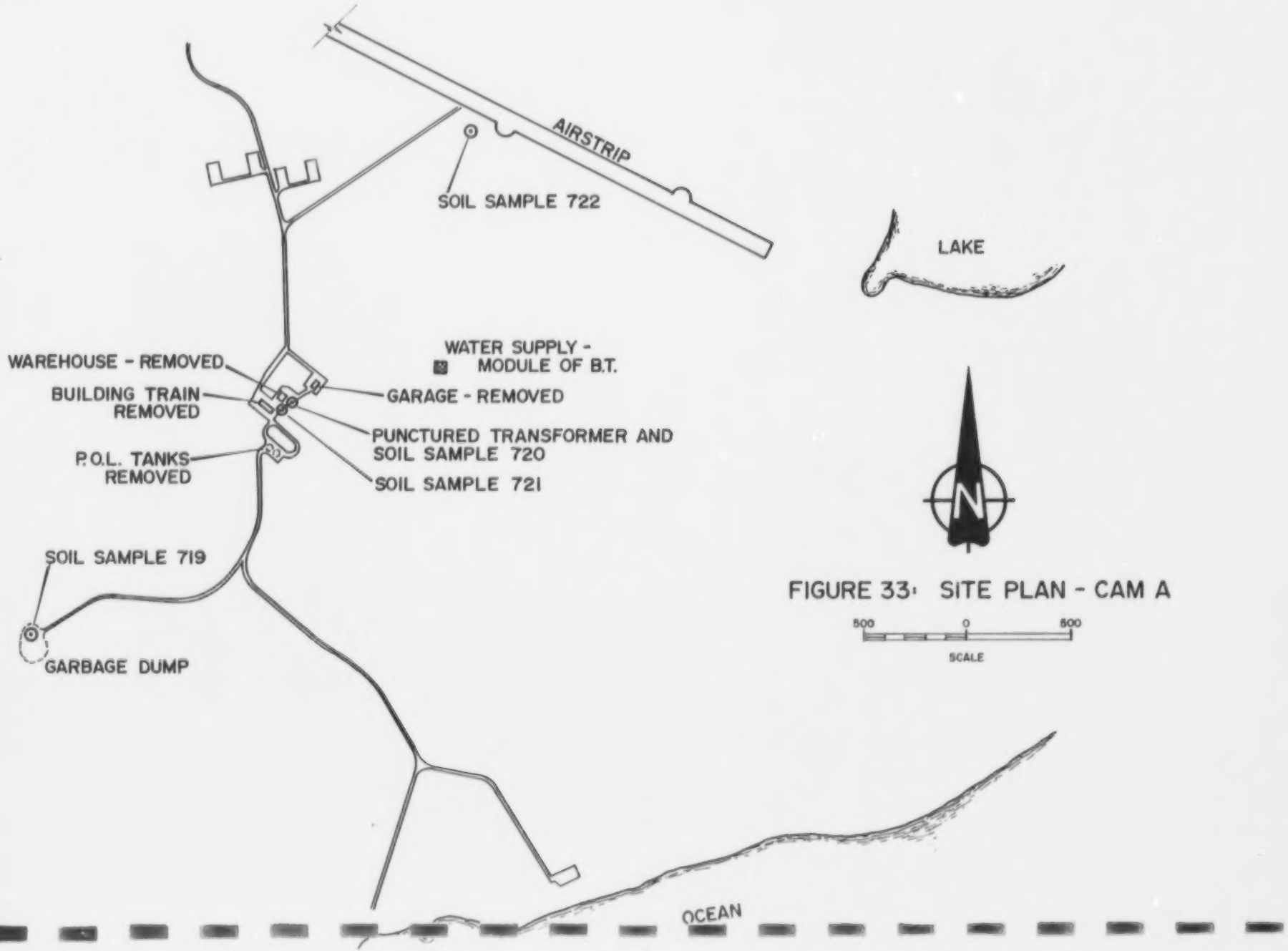


FIGURE 33: SITE PLAN - CAM A

3.1.11 Hat Island - CAM B

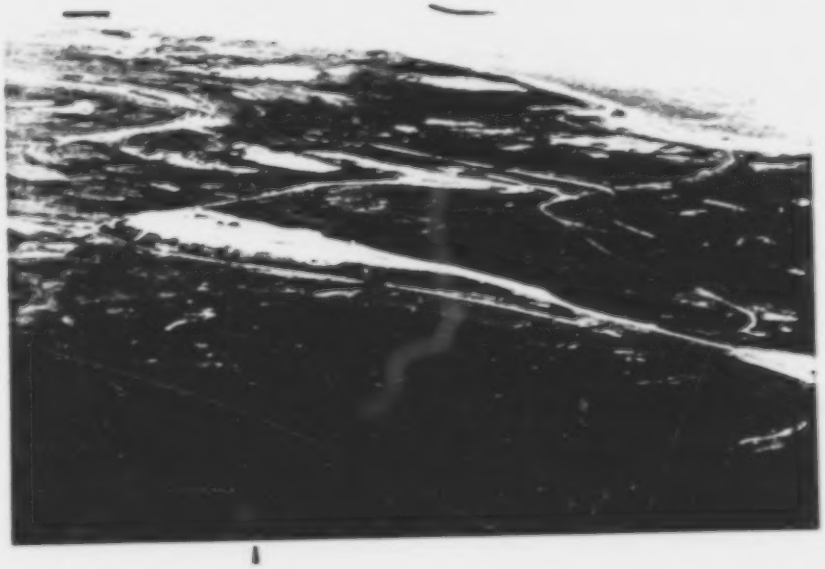
The Hat Island DEW Line site, 224 km east and south of Cambridge Bay in the Queen Maud Gulf, lies on the east side of Hat Island on a 41 m high plateau. The island was flat, rising to 18 m on average; the surface consisted of gravelly to sandy soil. Permafrost features were common in low lying wet areas. The vegetation consisted of sparse willow, moss, cotton grass and herbs (Figure 34).

The building train, one POL tank and the pumphouse remained on-site. The building train was badly damaged, with some equipment thrown outside. Several dumpsites were located which held PCB-containing equipment.

A runway lighting regulator was removed from the beaching area dump (Figure 35 - Dump 1). This regulator, unlike previously-found regulators, was liquid-filled. A soil sample confirmed that the area was not contaminated (Table 8). Two leaking capacitors were located outside the door of the building train next to the warehouse foundation (Figure 35 - Dump 4). The capacitors and soil were removed in an area 250 mm by 600 mm. No PCB/TCB odour was detected after clean-up, and the area was refilled with clean gravel. The soil analysis after clean-up (Table 8) indicated that high levels of contamination remained.

Two capacitors were found (Figure 35 - Dump 3) which appeared burnt and leaking. Soil analysis revealed that high levels remained after clean-up. The analytical results obtained for Dump 2 and Dump 3 can be attributed to the dilution of the original sample with non-contaminated soil, and the downward movement of the PCB liquid in the porous soil; thus an undiluted sample was obtained at depth. No odour of PCB/TCB was detected after clean-up owing to the cold temperature of the soil below the surface.

FIGURE 34: SITE OVERVIEW - HAT ISLAND



Two additional capacitors (Figure 35 - Dump 2) were located below the NAR house location. No soil sample was taken, as the capacitors were intact.

A soil sample taken at the base of the building train steps, where equipment was packaged into barrels, indicated a low level of contamination (Table 8). Low-level contamination had been detected in this general area during a previous survey (Holtz and Sharpe, 1984).

POL was found at several barrel storage areas and the on-site POL tanks. Twenty-nine drums of fuel, varsol and lubricating oil were destroyed. An estimated 13,000 to 18,000 L of diesel remained in the on-site POL tanks. The fuel was left because of the porous nature of the soil and the proximity of the tanks to the steep, sloped edge of the site. It was determined by EP and DND to be unsafe to burn the fuel.

Table 8 - PCB Residue Analysis - CAM B

Sample Number	Description	Aroclor	Amount (in ppm)
0713	Leaking capacitor: warehouse foundation (after)	1254	1,100
0714	Burned capacitor: before removal	1254	310
0715	Burned capacitor: after removal	1254	730
0716	Soil under runway regulator		L.1
0717	Outside steps	1254	9.6
0718	Background		L.1

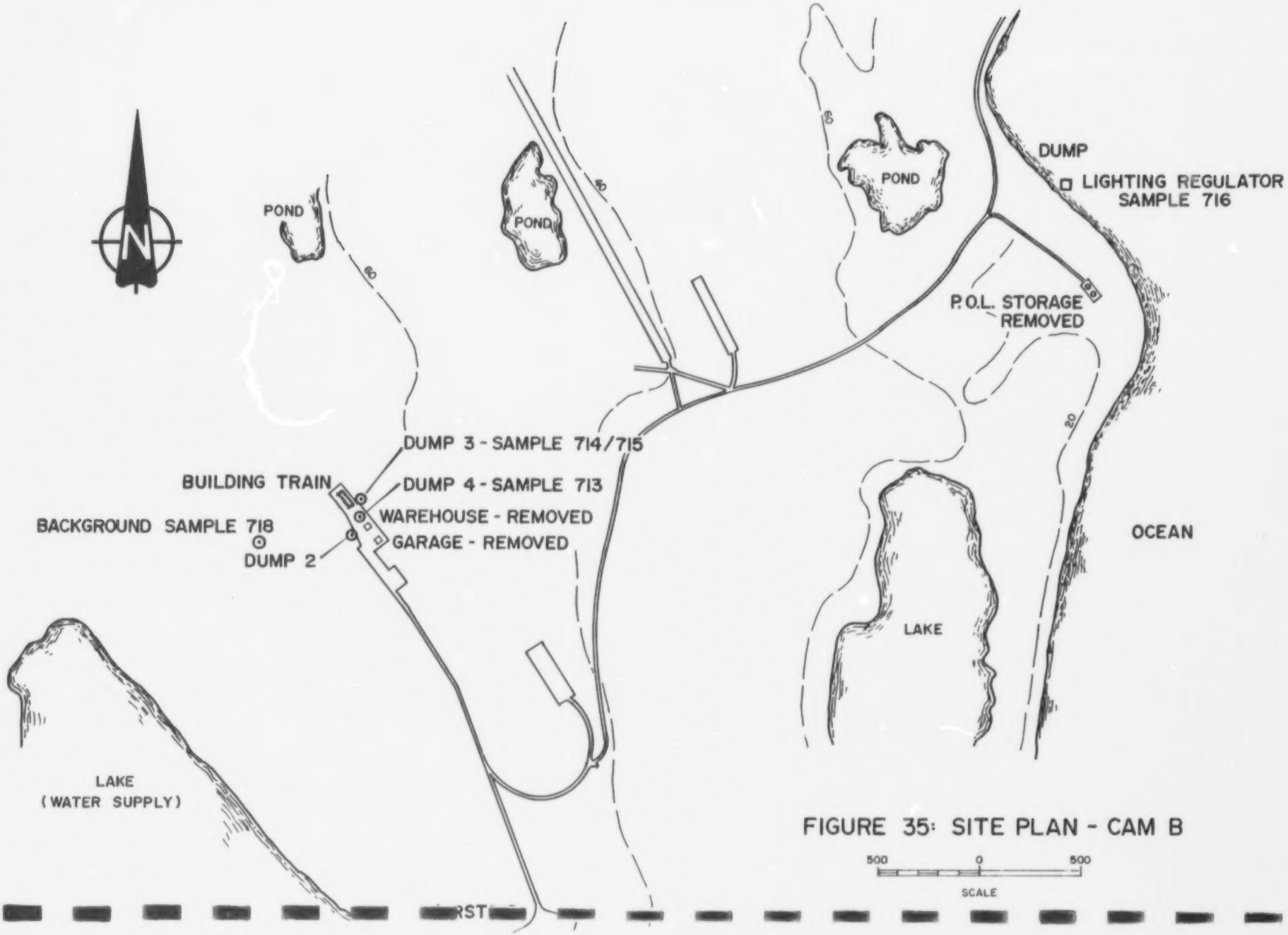


FIGURE 35: SITE PLAN - CAM B

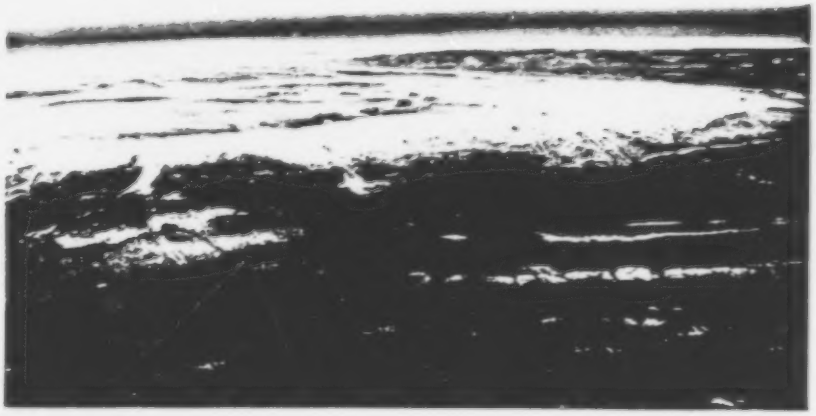
3.1.12 Matheson Point - CAM C

Matheson Point, 400 km east of Cambridge Bay, lies on a 70 m high prominence 1 km inland overlooking Rae Strait. The surrounding area of rolling hills consisted of coarse beach sand, well-sorted large gravel and limestone-type soil. Vegetation was minimal except along the coastline where grasses and sedges were common; inland it was composed of sedges and herbs (Figure 36).

Very little building remnants remained on the building site. Only the warehouse foundation, the felled tower and tank module were left. The tank module was northwest of the original building train location. Three transformers and six light ballasts were found on-site; the transformers were located by the warehouse foundation, the light ballasts in the tank module. An extensive burial site with debris protruding from it was located north, west and south of the building site pad (Figure 37). This may be where the missing buildings and electrical equipment are located.

Soil samples collected on-site, at the location of the building train and south of the site, revealed no detectable levels of PCB residues (Appendix A).

FIGURE 36: SITE OVERVIEW - MATHESON POINT



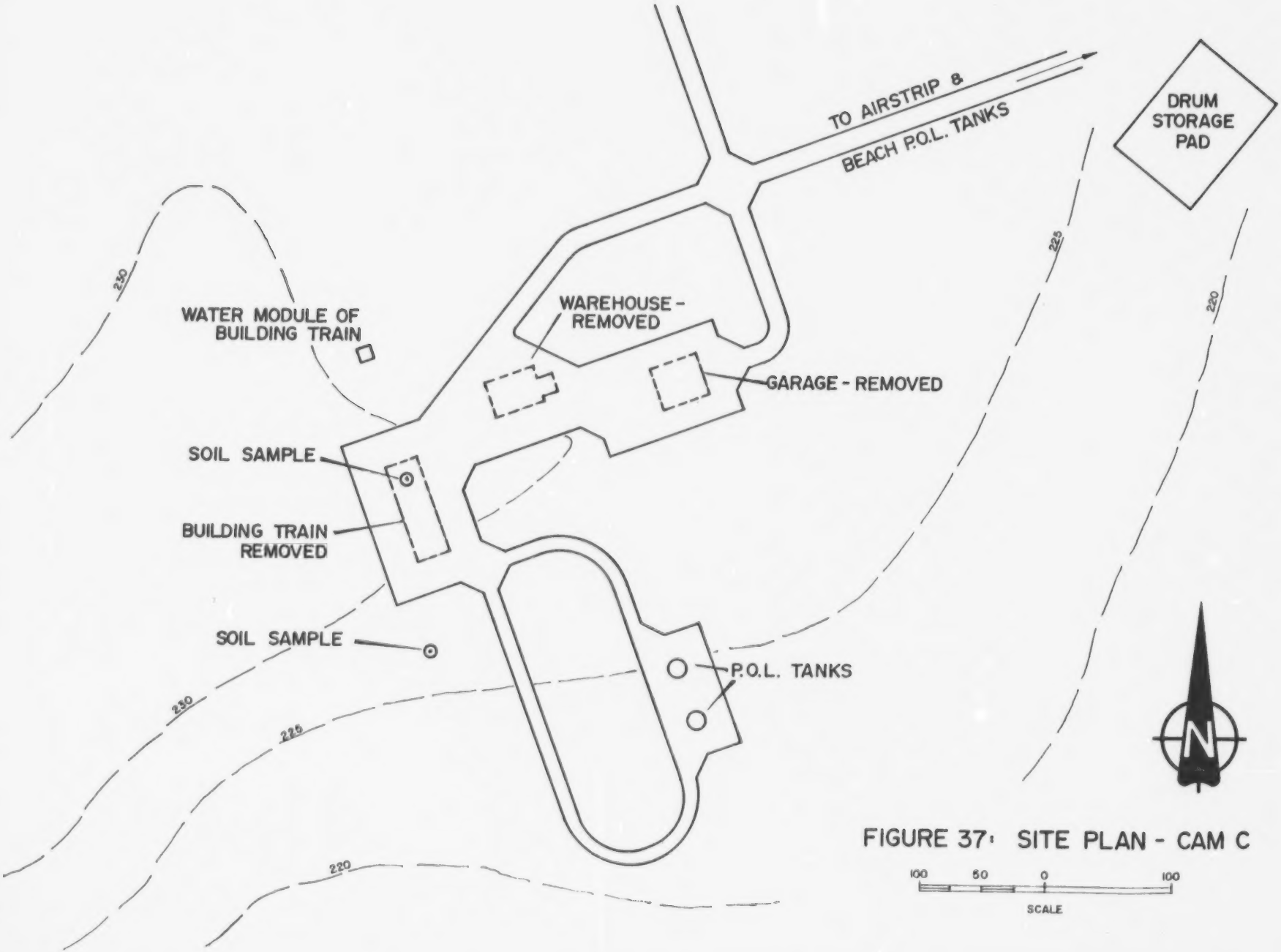


FIGURE 37: SITE PLAN - CAM C

3.1.13 Simpson Lake - CAM D

Simpson Lake, 530 km east of Cambridge Bay, lies 20 km inland on a hillside overlooking a small lake. The soil, covered with a thin layer of moss lichen/polygon net complex, was composed of a gravelly sand. The movement of vehicles during operation or construction had left the area extensively eroded (Figure 38).

The building train and warehouse had been demolished; the garage was intact. The cabinets from the communication room, and the de-icing motors, were found in a depression between the garage and POL tanks (Figure 39). The cabinets contained the full complement of equipment. The capacitors of the de-icing motors were leaking, so the stained soil and capacitors were removed.

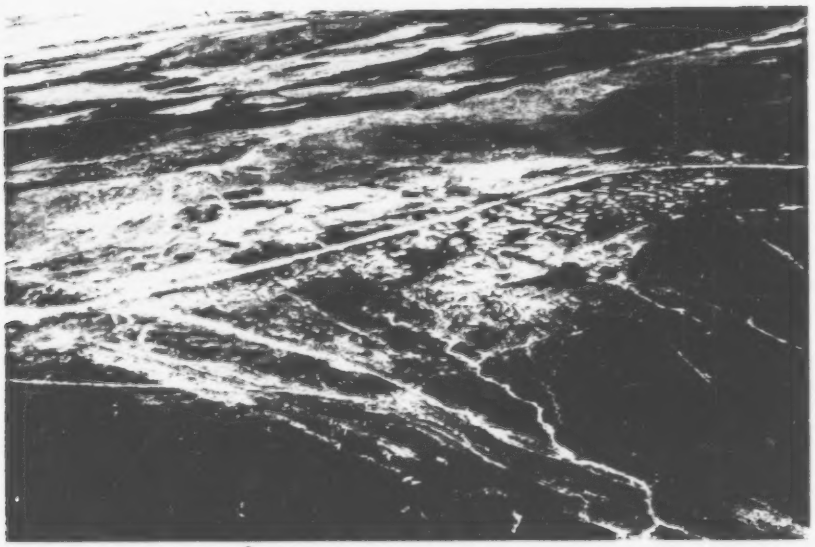
Soil samples were taken under the cabinets, around the motors and under the motors (Table 9). The results indicated that the area under the cabinets, and on-site, were contaminated at low levels, while the area under the motors was highly contaminated and the area around the motors remained with low-level contamination.

Several hundred drums were found at three locations (Figure 39). Fifty-nine drums containing lube oil, engine oil and gasoline were destroyed, and the one remaining POL tank was empty.

Table 9 - PCB Residue Analysis - CAM D

Sample Number	Description	Aroclor	Amount (in ppm)
0753	Base of cabinets	1254	4
0754	On-site background	1254	1.8
0755	Tundra - background		L.1
0756	Motors - capacitors removed	1254	13
0757	Motors - capacitors removed	1254	. 19
0758	Under motors - capacitors removed	1254	1,300

FIGURE 38: SITE OVERVIEW - SIMPSON LAKE



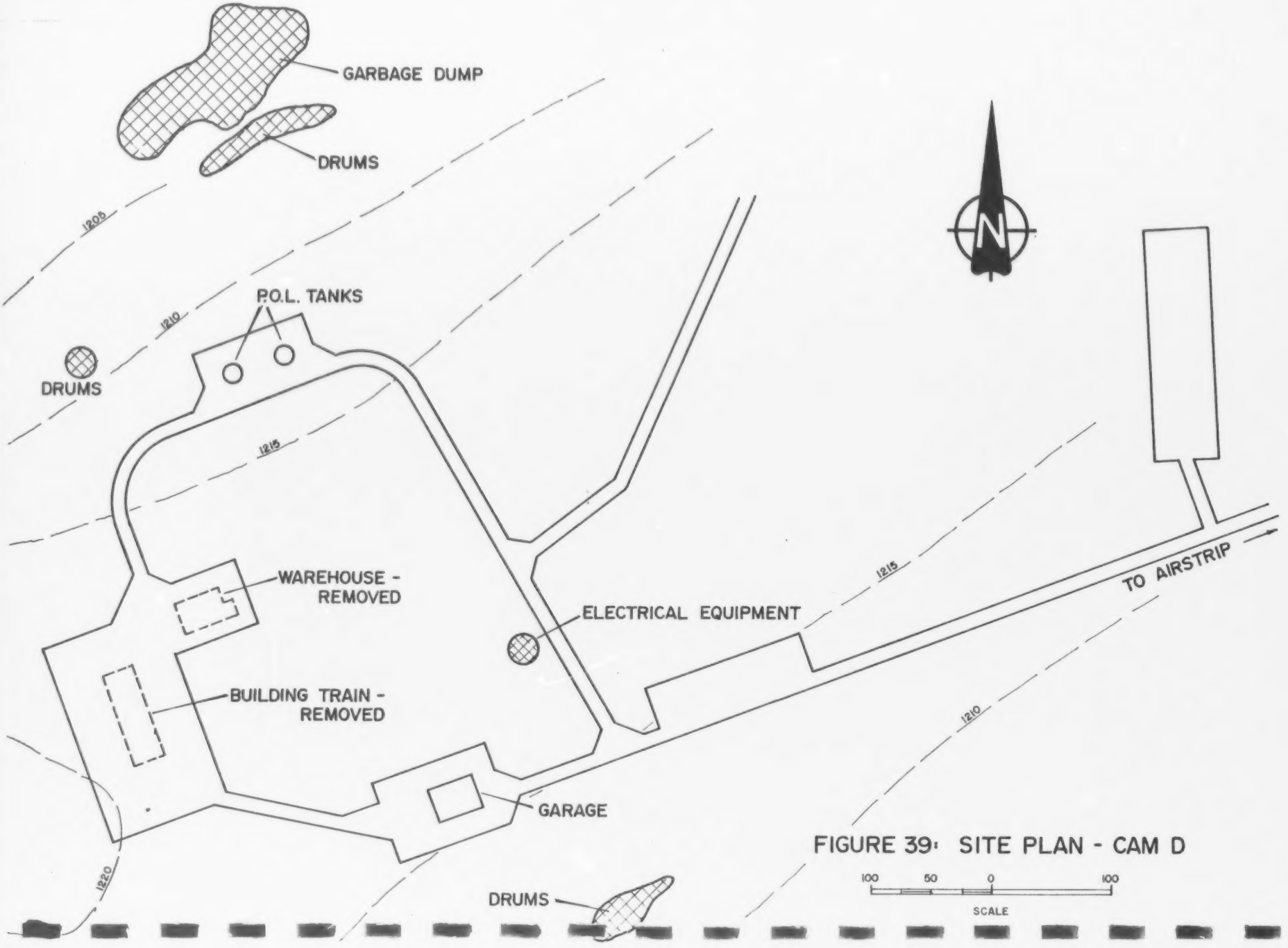


FIGURE 39: SITE PLAN - CAM D

3.1.14 Keith Bay - CAM E

Keith Bay, 230 km west of Hall Beach, lies 2.5 km inland on a 76 m high hill. The light, sandy soil supported sparse vegetation such as lichens, sedge and herb species (Figure 40).

The building site was demolished, with only the structural members of the garage remaining standing. As this was a site where Crown Assets had tendered the removal of equipment to Pelly Bay, equipment was removed from both the abandoned DEW Line site and from Pelly Bay.

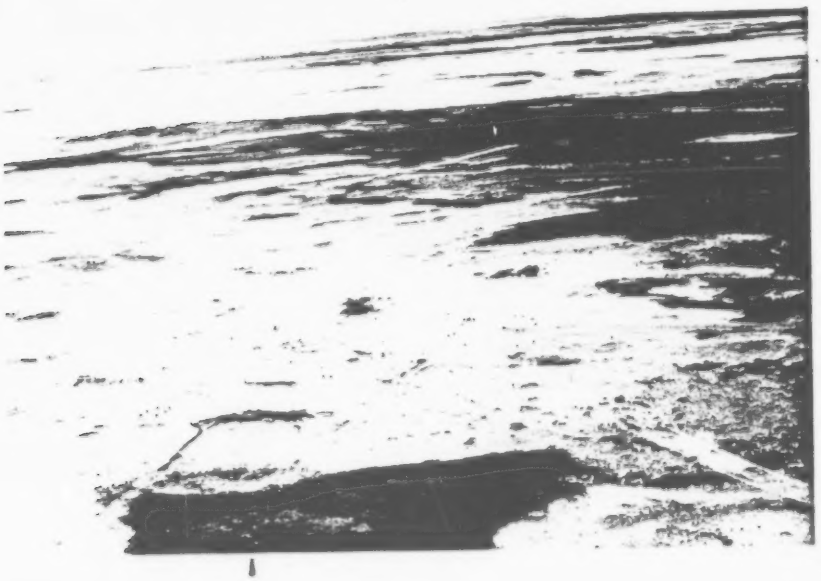
On the DEW Line site, the eight cabinets from the communication module were found empty near the airstrip (Figure 41). The PCB-containing equipment and de-icing motors were found in the rubble of the building train (Figure 41). Eight of the remaining twelve de-icing motor capacitors were found to be leaking.

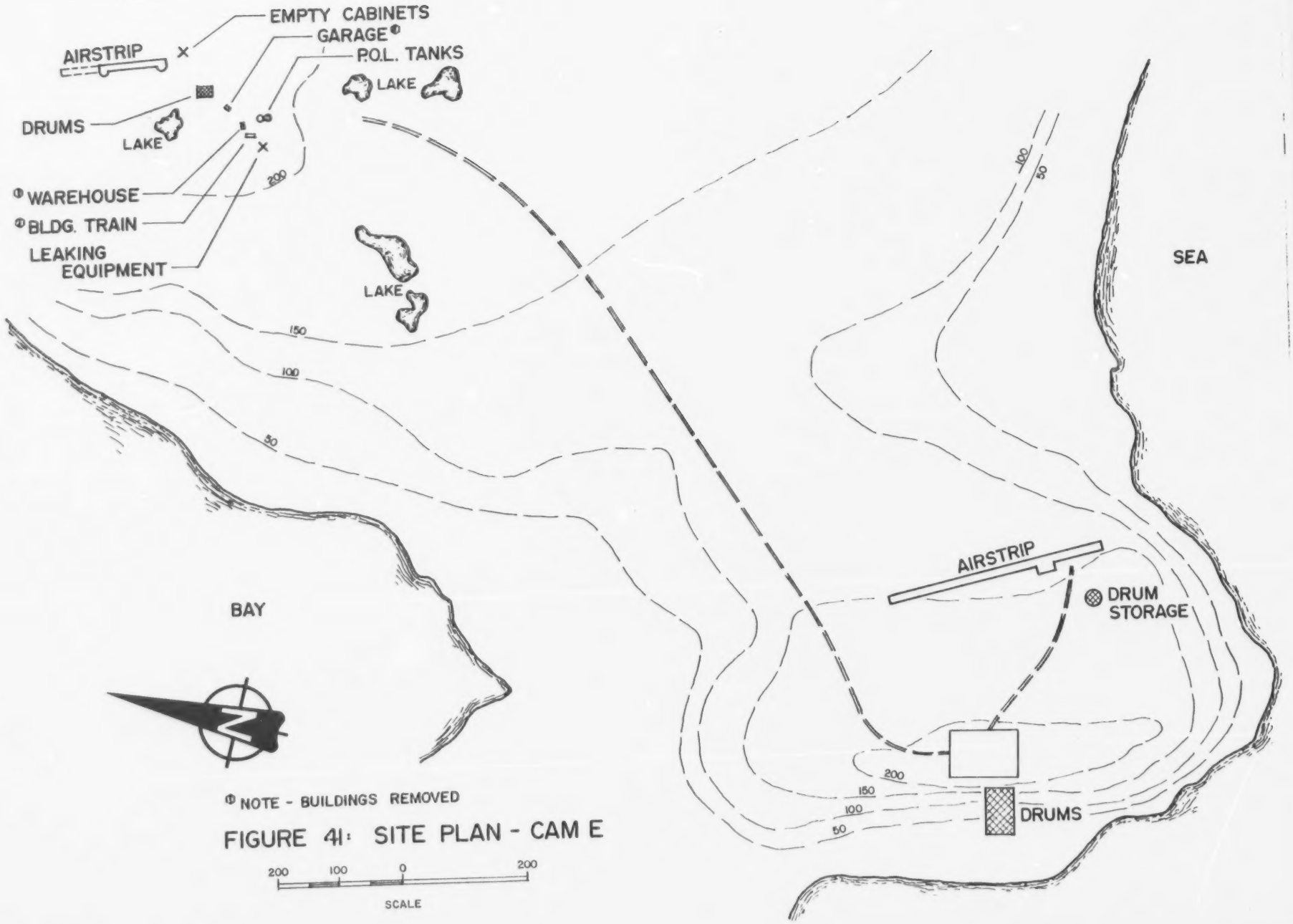
Soil was removed from the area under the motors and test results indicated that contamination remained (Table 10). On-site analysis indicated that a low level of contamination existed around the building site.

Equipment found at Pelly Bay consisted of one light ballast, 19 unidentified transformers, four unidentified capacitors and 11 panels of transformers and capacitors. During the removal of equipment from Pelly Bay, four bags (50 kg) of soil were removed from around the equipment owing to leaks.

The two original POL tanks had been removed from the DEW line site. Several storage areas existed with several hundred empty drums (Figure 41). Twenty-one drums of gasoline, diesel and engine oil were destroyed.

FIGURE 40: SITE OVERVIEW - KEITH BAY





① NOTE - BUILDINGS REMOVED

FIGURE 41: SITE PLAN - CAM E

200 100 0 200

SCALE

Table 10 - PCB Residue Analysis - CAM E

Sample Number	Description	Aroclor	Amount (in ppm)
0745	Leaking capacitor	1254	0.17
0746	Leaking capacitor	1254	55
0747	Leaking capacitor	1254	1,300
0748	Leaking capacitor		L.1
0749	Leaking capacitor	1254	3.9
0750	Leaking capacitor	1254	25
0751	Background near building train	1254	2.4
0752	Background away from building train		L.1

3.1.15 Sarcpa Lake - CAM F

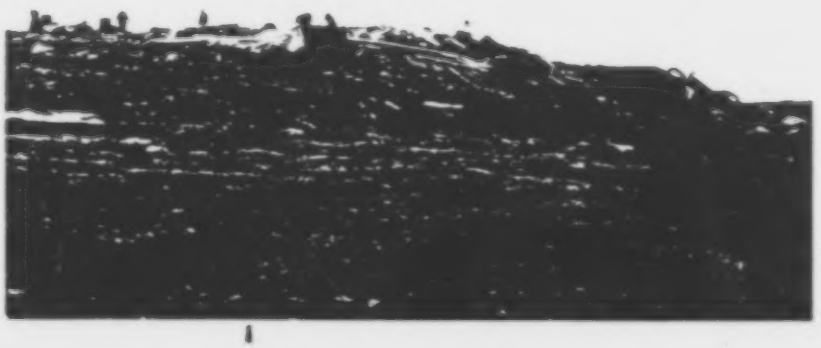
The Sarcpa Lake site lies inland 85 km west of Hall Beach on a hill 2 km north of the west arm of Sarcpa Lake. The surrounding area consisted of rocky outcrops of mountainous-type terrain, with numerous lakes and rivers. Vegetation was sparse, except in low-lying areas where grasses and sedges dominated (Figure 42).

When the abandoned site was converted to a field station by DIAND and York University in 1977, all the electrical equipment was cleared from the buildings and deposited at the north end of the site (Figure 43). The building train, NAR house and warehouse were structurally sound, the garage structural beams remained and a small Quonset-like hut had been rebuilt.

A dumpsite created by York University and a dumpsite from the DEW Line site held the PCB-containing equipment from the buildings. Most of the expected electrical equipment was found, with the exception of six de-icing motor capacitors. In the York University dump, eight large pyranol capacitors were found. Soil sample analysis revealed no significant contamination (Table 11) (Figure 43). Three additional pyranol capacitors were located in the DEW Line dump (Figure 43). Soil samples taken at the base of the dump indicated that PCBs were present in the soil at significant levels (Table 11). This indicated that more material may be buried in the dump, as the capacitors removed were not leaking. Soil samples taken at the entrance to the building train, near the building train and near the garage all revealed a low level of contamination around the site (Table 11) (Figure 43).

No POL was found in the on-site tanks. Two drums of oil were found and destroyed.

FIGURE 42: SITE OVERVIEW - SARCPA LAKE



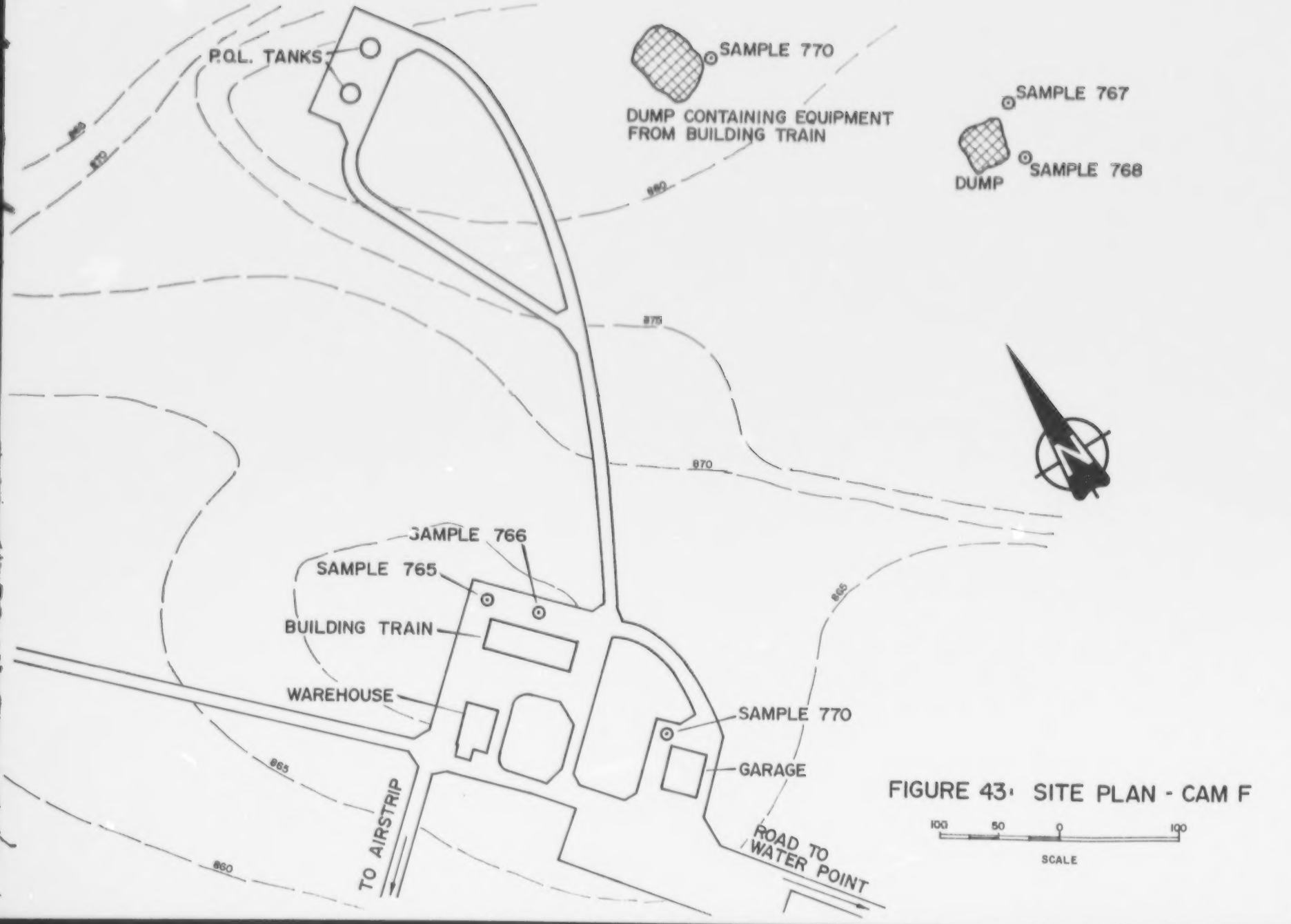


FIGURE 43: SITE PLAN - CAM F

Table 11 - PCB Residue Analysis - CAM F

Sample Number	Description	Aroclor	Amount (in ppm)
0765	North entrance of building train	1254	59
0766	Near building train	1254	10
0767	Base of original dump	1254	190
0768	Base of original dump	1254	1.6
0769	Base of university dump		L.1
0770	On-site for background	1254	5.7

3.1.16 Rowley Island - FOX 1

Rowley Island is located 120 km north and east of Hall Beach on an island with an average elevation of 50 m. The coarse, sandy soil supported grass and sedge-type vegetation (Figure 44). As this was the only auxiliary site abandoned, the amount and type of equipment expected was unknown. The 25-module building train was still standing, but was in poor condition because of vandalism; the garage and warehouse had been demolished. Twelve drums of equipment were removed, and only the light ballasts were positively identified as containing PCBs. Three large transformers were located and found to be nitrogen-filled.

Samples were collected on the warehouse foundation, at stains around the site, at the base of a power pole and on-site for background (Figure 45). The results of the analyses (Table 12) indicated that a low level of contamination existed on the warehouse foundation and at the power pole. Other results indicated no contamination.

Six drums of lube oil and diesel were burnt on site. Because of safety hazards, 75,000 L of diesel in the POL tanks, 116 drums of diesel fuel and 20 drums of oil were left.

Table 12 - PCB Residue Analysis - FOX 1

Sample Number	Description	Aroclor	Amount (in ppm)
0723	Composite - warehouse foundation	1254	24
0724	Ground stains by building train		L.1
0725	Base of power pole (west of bldg.)	1254	2.6
0726	On-site (background)		L.1

FIGURE 44: SITE OVERVIEW - ROWLEY ISLAND

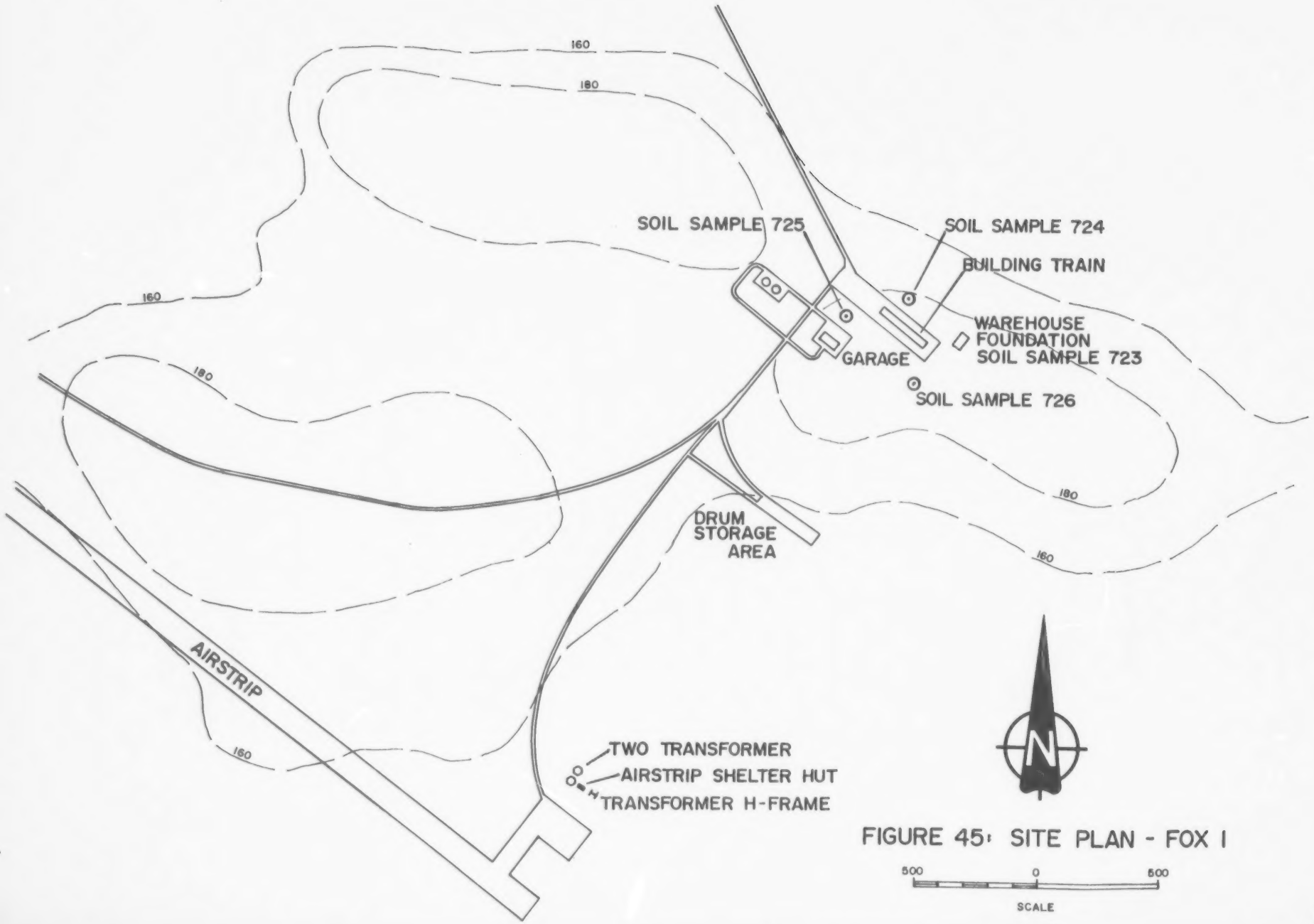


FIGURE 45: SITE PLAN - FOX I

3.1.17 Bray Island - FOX A

The Bray Island abandoned site is located 180 km north and east of Hall Beach on a low lying island with an elevation of 21 m. The soil and vegetation were similar to Rowley Island (Figure 46). The building site had been vandalized, and only the garage and Inuit house remained intact. The warehouse had been leveled and the building train was in poor condition, with most of the sheet metal removed from the exterior wall. The communication room cabinets were stripped of all their components, and electrical equipment was strewn about the floor of the building train. Small transformers were found outside the NAR house (Figure 47). One transformer and seven capacitors were found at the beaching area, but none were leaking. Some of the PCB-containing capacitors - de-icing motor capacitors - were missing, although most other electrical equipment was accounted for and removed.

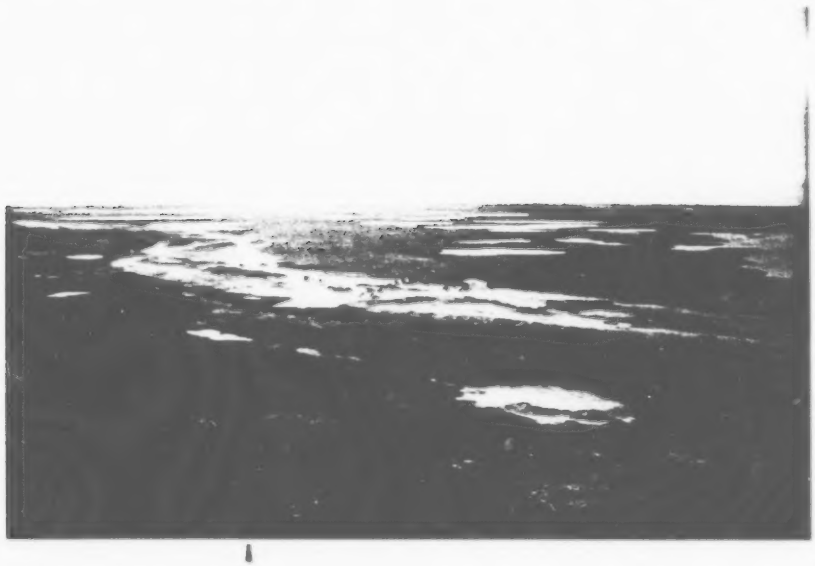
Soil samples taken at the base of the stairs at the main entrance to the building train indicated PCB contamination (Table 13). Analysis of samples from the work area also indicated that low levels of contamination existed in this area. A background sample analysis indicated no detectable PCB levels off-site.

The four POL tanks were empty. POL was found in 5 drums at the end of the runway. Two diesel fuel drums, two lube oil drums and one naphtha fuel drum were destroyed.

Table 13 - PCB Residue Analysis - FOX A

Sample Number	Description	Aroclor	Amount (in ppm)
0727	Base of stairs to main entrance	1254	78
0728	Work area	1254	9
0729	Background - off-site		L.1

FIGURE 46: SITE OVERVIEW - BRAY ISLAND



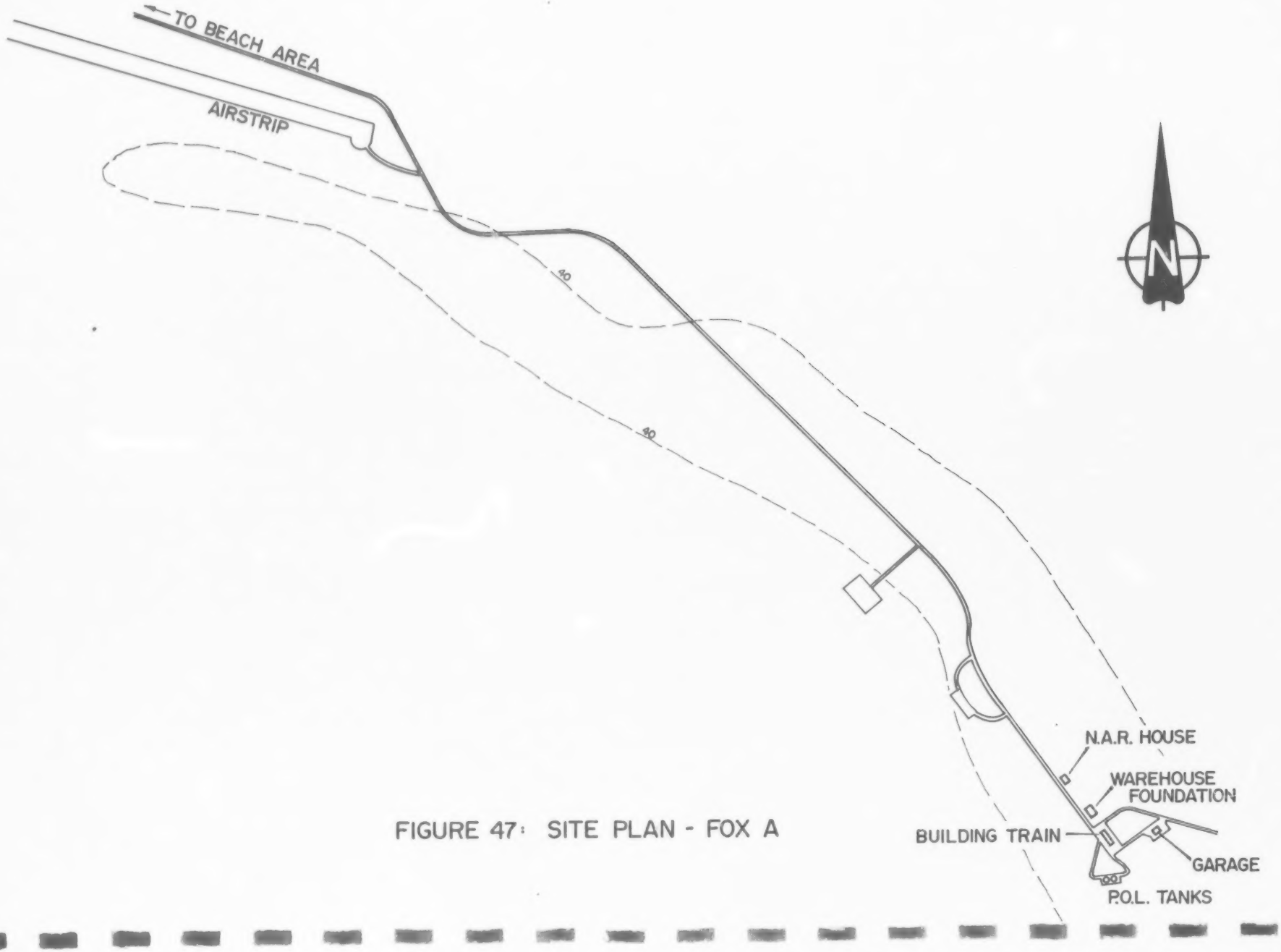


FIGURE 47: SITE PLAN - FOX A

3.1.18 West Baffin Island - FOX B

West Baffin is located 320 km east of Hall Beach, 20 km inland on the west side of Baffin Island. The site sat on a 45 m high hill at an elevation of 150 m. The area was characterized by gently rolling rocky hills, broad grass/sedge valleys, wetlands and lakes (Figure 48).

The abandoned site was relatively untouched; the buildings were intact and in use as a scientific research facility by DIAND. All the electrical equipment had been removed from its original locations.

One extra transformer (leaking) and soil was removed from a dump north and east of the building site. Analysis of the soil under the transformer indicated that it may have contained contaminated oil (Table 14) and the dump site may have been contaminated at low levels. Samples taken at the work area, a stained area near the building train and from an on-site background location (Figure 49) indicated that low-level contamination existed at the first two locations (Table 14).

No POL was found on-site.

Table 14 - PCB Residues Analysis - FOX B

Sample Number	Description	Aroclor	Amount (in ppm)
0759	Downhill edge of dump	1254	2.6
0760	Beneath leaking transformer	1254	57
0761	On-site for background		L.1
0762	Stain near building	1254	0.30
0763	Work area	1254	2.5
0764	Base of stairs at main entrance	1254	11

FIGURE 48: SITE OVERVIEW - WEST BAFFIN ISLAND

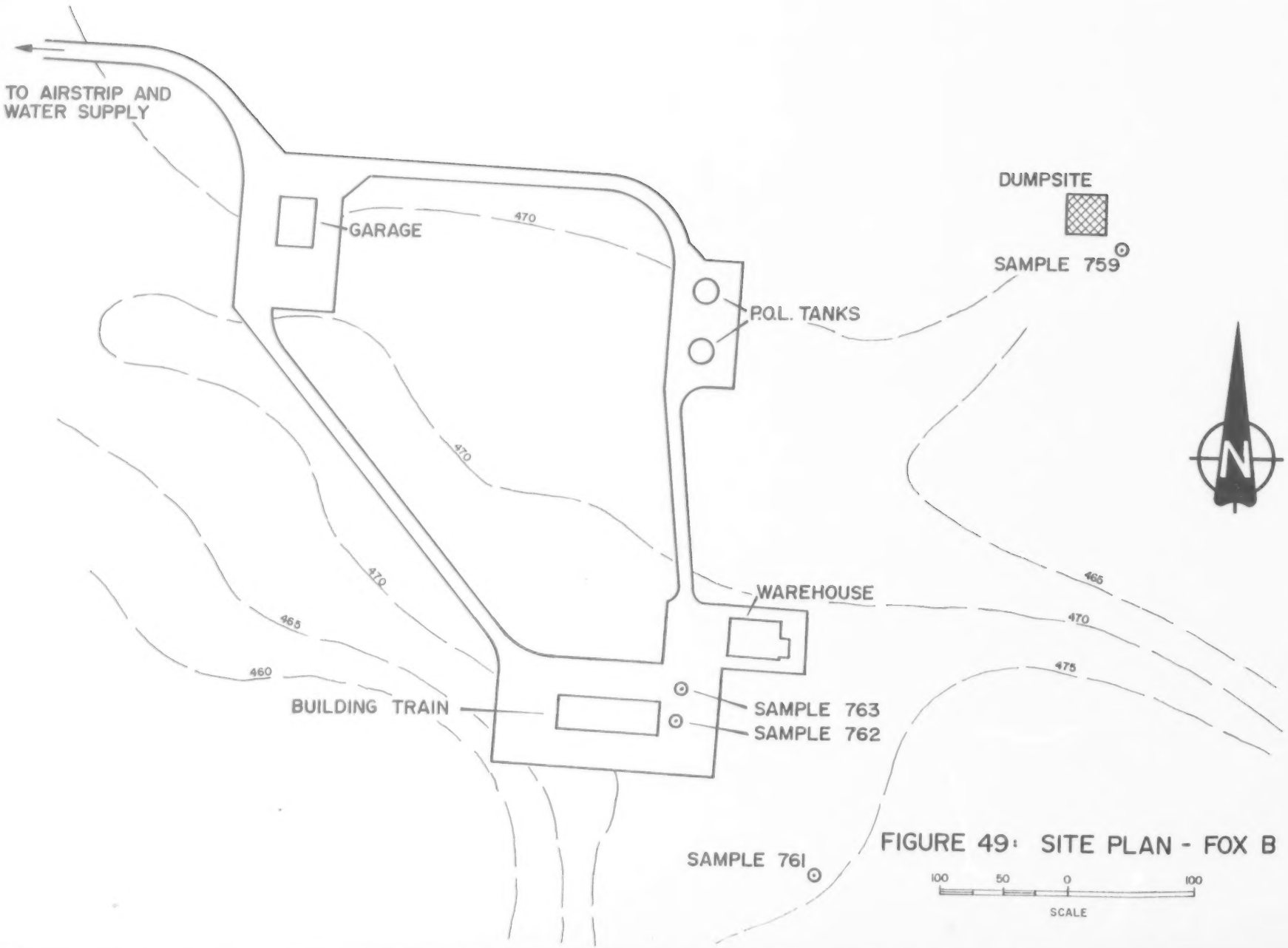


FIGURE 49: SITE PLAN - FOX B

3.1.19 Ekalugad Fjord - FOX C

Ekalugad Fjord, located 320 km north of Cape Dyer on the east coast of Baffin Island, lies 1.5 km from the coast on a steep, rocky, 730 m high mountain top. Vegetation consisted of small patches of lichen encrusted on rock faces. The area was characterized by glaciers and steep-walled fjords (Figure 50).

All the buildings had been heavily vandalized but were still in relatively good structural condition. The electrical equipment was present and intact before removal. Twelve 1-gal. tins of electrical insulating oil and cutting oil were also removed.

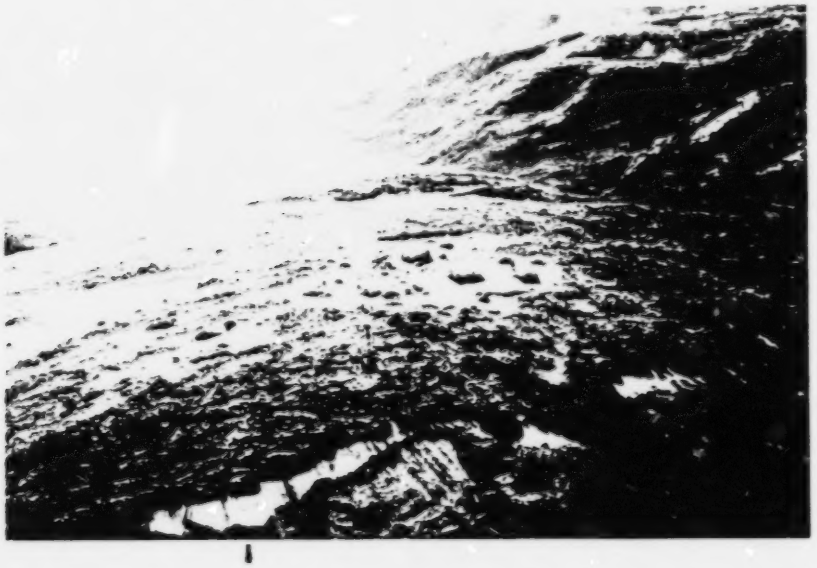
Soil samples (Figure 51) on-site indicated that a minor level of contamination existed around the building train (Table 15). Other site samples produced no detectable levels of PCB residue.

All of the POL tanks were empty. Numerous caches of drums were found around the site. Only 50 drums of POL were burned, with 75 drums left full, owing to the sensitivity of the location and hazard to workers.

Table 15 - PCB Residue Analysis - FOX C

Sample Number	Description	Aroclor	Amount (in ppm)
0736	Base of stairs at main entrance	1254	11
0737	Work area near main entrance	1254	2.7
0738	Around stain		L.1
0739	Ground stain		L.1
0740	From surface on-site		L.1

FIGURE 50: SITE OVERVIEW - EKALUGAD FJORD



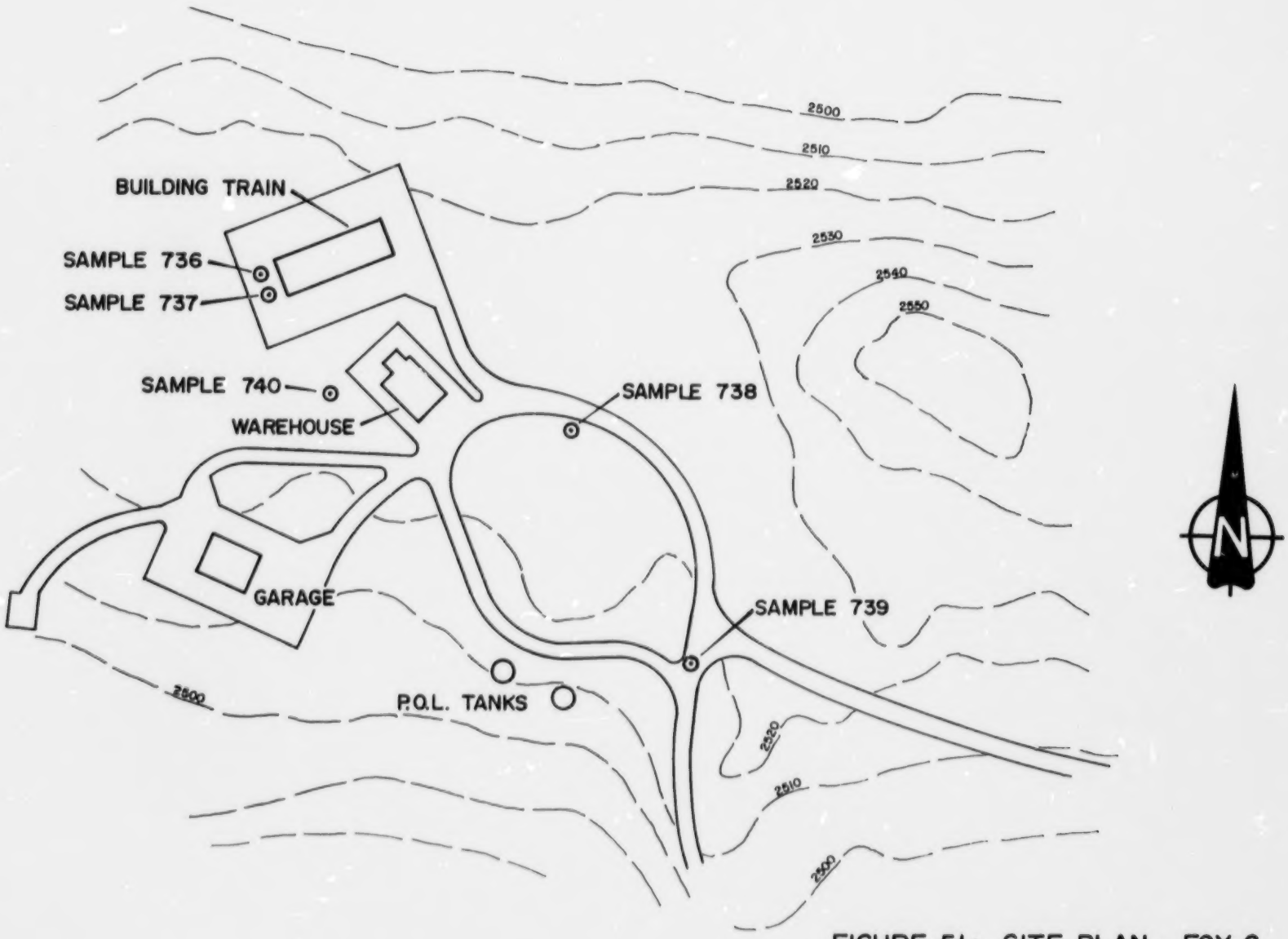


FIGURE 51: SITE PLAN - FOX C

3.1.20 Kivitoo - FOX D

Kivitoo, located 200 km north of Cape Dyer on Baffin Island, lies on a 427 m high rocky coastal hill. The site consisted of large coarse gravel and rock (Figure 52). This was the only site known to have burned down during its operation in the 1950s. New equipment was reported to have been brought to the site, but no confirmation of this has been made in written reports. It was expected that eight sets of communication equipment and electronic gear would be found.

The site had no buildings, only burnt rubble which had been discarded down the northeast slope of the site (Figure 52). Most of the material had been covered with gravel. Two communication cabinets were found at the top of the burial site; both contained a full complement of electrical equipment and both were breached by fire. The ashes and electrical equipment were removed. The ashes were sealed in plastic bags before being barreled. Two small capacitors and a light ballast were removed from the former warehouse foundation location.

Soil samples revealed no significant PCB residues except one ash sample taken from one of the cabinets (Table 16). There have been unconfirmed reports of materials being dumped into the ocean, but no evidence was found. No POL was found on site.

Table 16 - PCB Residue Analysis - FOX D

Sample Number	Description	Araclor	Amount (in ppm)
0771	Ground stain		L.1
0772	Work area	1254	1.2
0773	Work area around cabinet 2		L.1
0774	Composite from base of landfill		L.1
0775	Ashes from cabinet 1	1254	15,000
0776	Ashes from cabinet 2		L.1

FIGURE 52: SITE OVERVIEW - KIVITOO

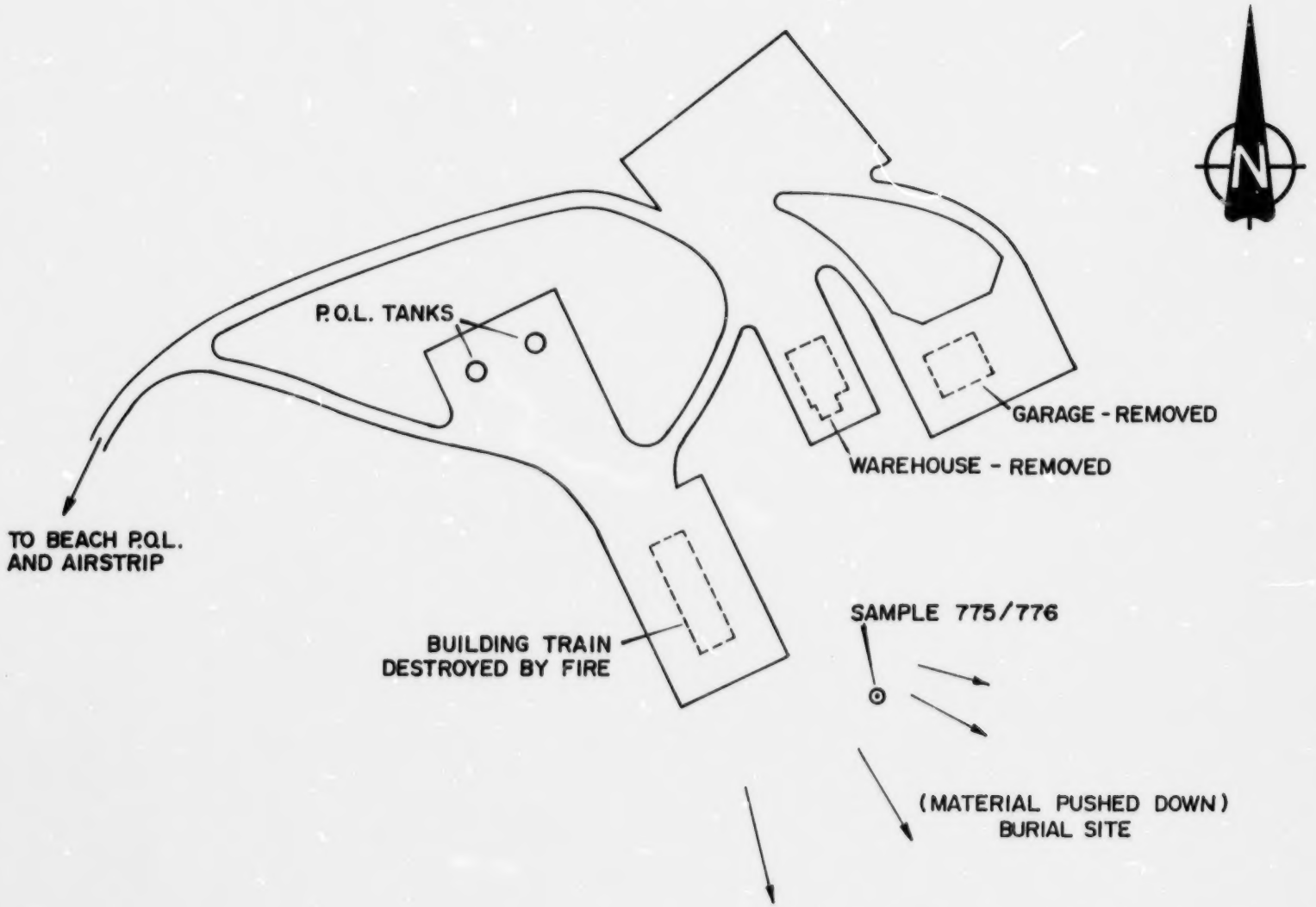


FIGURE 53: SITE PLAN - FOX D

3.1.21 Padloping Island - U.S. Coast Guard

Padloping Island, 70 km north of Cape Dyer on a small island off the east coast of Baffin Island, lies a few hundred metres inland just above sea level. The ground was in a state of continuous permafrost action, as indicated by large rocks and boulders scattered over the area. The area had an estimated 23° slope to the water's edge with sedge, grass and moss growing in flat areas between rocks (Figure 54).

As this was the only Coast Guard/weather station visited, it bore no resemblance to any other sites. All seven buildings had been completely demolished with only foundations remaining. Included were an incinerator building, boiler building, quonset huts and hunter cabins.

An operations manual obtained from an abandoned Coast Guard site at Cape Christian, NWT, indicated that very few pieces of original electrical equipment in the cabinets were PCB-containing. Although five drums of electrical equipment were removed from the site, only a few panels of capacitors were suspected of containing PCB liquid. Most of the electrical equipment was found in a dump between the building site and the ocean. Soil sample analysis from around the dump indicated that low level residues were present underneath two electrical cabinets (Table 17). Other analyses indicated no detectable PCB levels.

The only POL found consisted of four drums of oil which would not ignite and were left. Other contaminants left and judged non-toxic to the environment included caustic soda in cans, ferro silicon in 2 kg bags and asbestos tiles.

FIGURE 54: SITE OVERVIEW - PADLOPING ISLAND

Table 17 - PCB Residue Analysis - U.S. Coast Guard

Sample Number	Description	Aroclor	Amount (in ppm)
0730	Seaward edge of dump		L.1
0731	Seaward edge of dump		L.1
0732	Beneath cabinets with equipment	1254	1.3
0733	Between the two cabinets	1254	2.5
0734	Surface - beneath cabinets		L.1
0735	6" depth - beneath cabinets		L.1

3.1.22 Durban Island - FOX E

The Durban Island site, located 70 km north of Cape Dyer near Padloping Island, lies on Aggiden Island on the east side of Baffin Island at an elevation of 670 m. The DEW Line station was located on a plateau on top of a steep sloped hill with no vegetation evident on the site. The soil consisted mainly of rock, permanent ice and loose, coarse gravel (Figure 55).

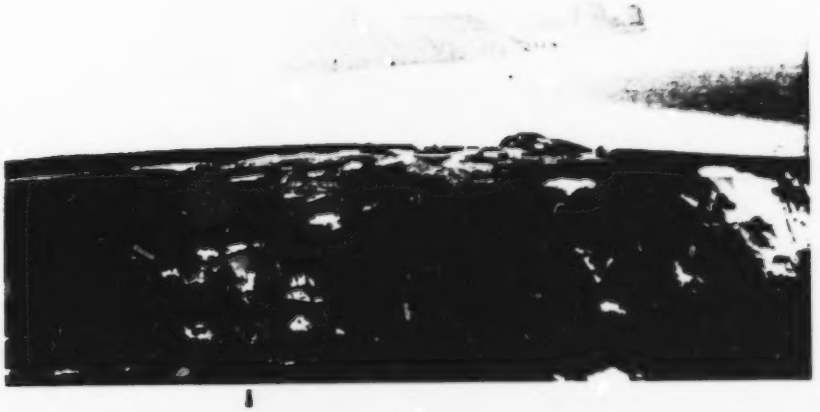
All the buildings were in good structural condition with all the electrical equipment intact. Numerous spare transformers and capacitors were located in the warehouse (Figure 56) among scattered debris. One transformer was found to the west of the building site (Figure 56). No equipment was found leaking.

Soil sample analysis revealed that no significant contamination was present on the site (Table 18). One surface sample (0741) was re-analyzed and found to contain trace PCB residues.

Table 18 - PCB Residue Analysis - FOX E

Sample Number	Description	Aroclor	Amount (in ppm)
0741	Surface sample	1254	0.19
0742	6" depth		L.1
0743	Surface sample (off-site)		L.1
0744	6" depth		L.1

FIGURE 55: SITE OVERVIEW - DURBAN ISLAND



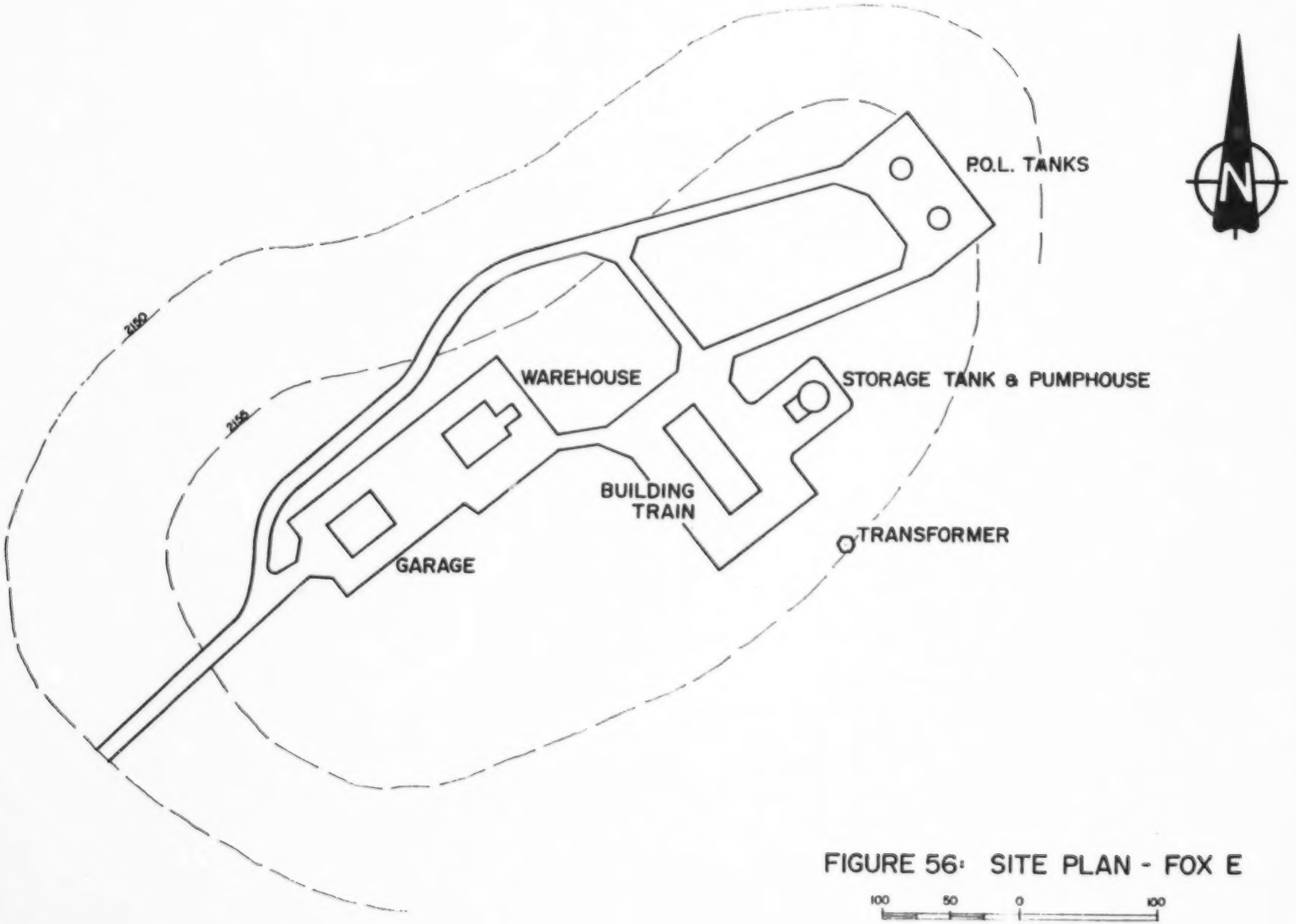


FIGURE 56: SITE PLAN - FOX E

100 50 0 100

SCALE

3.2 Results of Clean-up of Hazardous Materials

The objective of the individual site clean-up was to remove all visible/surface contaminants which could be found, without removing large quantities of soil. At some sites, all the PCB-containing equipment was found and removed. At other sites, the PCB-containing equipment was missing and was assumed to have been removed or buried. At sites such as Stokes Point, Tununuk, Atkinson Point, Durban Island and Kivitoo, indications of buried equipment were evident. Equipment from the Keith Bay DEW Line site was removed from the Pelly Bay townsite; therefore, it is suspected, as in the case of Cape Peel and Sturt Point, that missing equipment may now reside in the communities near the abandoned sites.

One hundred and thirty-six drums containing 2,449 pieces of equipment were removed from the 22 abandoned sites in 28 days. Included in the drums were 230 kg. of soil and contaminated clothing from the clean-up. This represents 70% of the total anticipated quantity of PCB-containing equipment.

PCB-contaminated liquid totaling 4,818 L was estimated to be contained in a total of 2,449 pieces of equipment. A breakdown of the equipment quantity and volumes per site is listed in Table 19. The amounts of material removed from all the sites are listed in Table 20. No attempt was made to estimate the amount of liquid contained in the equipment removed from Rowley Island and Padloping Island. As these sites did not coincide with the standard form of the intermediate sites, no estimation of the types or number of pieces expected to be found at these sites could be made.

Table 19 - PCB Equipment at Each I-Site

Number of Pieces	Equipment Type	Size	Approx. Quantity of PCB Liquid
16	Transformer Filament	1600V/25KV	72 L
8	General Electric Pyranol Capacitors	10KVDC	108.9 L
66	Small Capacitors	5x10x10 cm (average)	30 L
1	Current Regulator		12 L
8	De-icing Motor Capacitors	10x10x15 cm	18 L
	TOTAL		240.9 L

There were 540 drums of varsol, lubricating oil, diesel and aviation fuel found on the sites. Of these, 202 drums were disposed of by burning and 338 drums were left because of sensitivity of the environment (uncontrollable release down a steep slope or too much dry vegetation), because the material would not ignite, or because it posed a personnel hazard if ignited. POL tanks remained at 13 sites; four sites had POL remaining in the tanks (Table 20). Tanks at Stokes Point were being used by offshore drilling crews, while those at Atkinson Point were left at the request of the Reindeer Herding Station operator. The tank at Hat Island was left because of environmental sensitivity, and the tanks at Rowley Island were left at the request of the community.

Of the 22 sites, 19 sites require further evaluation because of the unknown location of equipment, the presence of PCB residues, or POL remaining at the site (Table 21). Only three sites (Horton, Clifton, and West Baffin) are considered contaminant-free. The sites at Tununuk, Atkinson Point, Cape Peel, Sarcpa Lake and Kivitoo should be considered priority sites for further consideration and re-evaluation.

TABLE 20

Equipment Removed from Abandoned DEW Line Sites.

Location	Pyranol Capac	Motor Capac	Ballast	Various Capac	Various Trans.	Choke	Panel	Soil (kg)	Drums POL	POL Tanks	Drums of Equipment	Total Pieces
Typical Site	8	18	25	35	68	16	3	--	--	--	8 or 9	.160
Stokes Point	0	0	1	0	0	0	0	--	17(F)	4/4(P)	0	1
Tununuk	0	0	2	1	2	0	0	--	117(F)	0	2	5
Atkinson	6	1	17	5	28	7	3	10	--	4/4(P)	6	67
Horton R.	8	19	17	26	68	13	3	50	4(D)	4/4	8	157
Pearce P.	8	18	24	34	60	8	2	--	57(F)	4/4	8	154
Clifton P.	8	20	25	35	68	13	3	--	13(D)	0/4	7	172
Bernard H.	8	4	0	15	68	7	3	--	10(D)	0/4	6	105
Ross Point	10	0	23	35	62	11	0	5	2(D)	0/4	8	141
Cape Peel	0	1	6	2	1	0	0	5	--	0/4	1	10
Sturt Point	0	0	2	0	0	0	0	0	--	0/4	0	2
Hat Island	8	5	10	23	73	16	2	10	29(D)	1/4(P)	6	135
Matheson P.	0	0	6	0	2	1	0	--	--	0/4	3	9
Simpson Lake	8	18	9	16	48	16	0	--	59(D)	1/2	7	115
Keith Bay	8	12	3	14	71	16	11	90	21(D)	0/2	9	137
Sarcpa Lake	11	12	18	26	68	16	1	--	2(D)	2/2	8	153
Rowley Is.	N/A	N/A	109	133	27	N/A	2	--	**6(D)	4/4(P)	12	343
Bray Is.	8	6	28	41	65	16	1	--	5(D)	4/4	8	164
West Baffin	10	18	27	40	68	16	0	10	0	2/2	9	179
Ekalugad Fj.	8	18	32	35	55	16	0	--	*50(D)	4/4	9	161
Kivitoo	2	0	4	12	15	0	4	50	0	2/4	5	37
Padloping Is.	N/A	N/A	13	40	62	N/A	N/A	--	4(F)	0	5	115
Durban Is.	8	0	30	37	35	16	0	--	1(D)	5/5(E)	9	126

(P) - one or more with fuel partially full
(F) - left on site full
(D) - destroyed
(E) - empty

* - 75 remaining full
** - 68 remaining full
N/A - not applicable

Table 21: Site Status

Location	Equipment Status	PCB Residues*	POL Status	Site Status
Stokes Point	unknown/burial	-	17 drums	follow-up
Tununuk	unknown/burial	detectable	117 drums	follow-up
Atkinson	buried	detectable	transferred	follow-up
Horton River	removed	detectable	destroyed	clean
Pearce Point	removed	non-detectable	57 drums	follow-up
Clifton Point	removed	non-detectable	destroyed	clean
Bernard Harbour	unknown	detectable	10 drums	follow-up
Ross Point	unknown	non-detectable	destroyed	follow-up
Cape Peel	unknown	detectable	none	follow-up
Sturt Point	unknown	detectable	none	follow-up
Hat Island	unknown	detectable	destroyed	follow-up
Matheson Point	unknown	non-detectable	none	follow-up
Simpson Lake	removed	detectable	destroyed	follow-up
Keith Bay	removed	detectable	destroyed	follow-up
Sarcpa Lake	buried	detectable	destroyed	follow-up
Rowley Island	unknown	detectable	left	follow-up
Bray Island	unknown	detectable	destroyed	follow-up
West Baffin	removed	detectable	destroyed	clean
Ekalugad Fjord	removed	detectable	75 drums	follow-up
Kivitoo	unknown	detectable	none	follow-up
Padloping Island	unknown	non-detectable	4 drums	follow-up
Durban Island	unknown	non-detectable	none	follow-up

* Residue results are of a reconnaissance type only and do not represent a comprehensive sampling program.

4.0 Discussion

Although adjustments were made to the planned procedures because of individual site conditions and remote locations, they generally worked well. The reconnaissance of a site by the crew commander and advisor prior to crew deployment was found to be of paramount importance in ensuring that procedures could be properly modified. Good prior planning, especially on the part of the military, resulted in the safe and efficient movement of personnel, equipment and waste. Because of effective planning and good weather, the planned 45-day clean-up was accomplished in 28 days.

Several factors were considered when site assessments were performed. Sites from which all PCB-containing equipment had been removed, background samples (composite samples taken around the site at random spots) analyzed as confirmation, were considered PCB-free, as in the case of Horton River, Clifton Point and West Baffin. However, owing to the limited reconnaissance-type sampling method used, hot spots could have been missed. The 19 locations identified as having unknown status or possible burial sites (Table 21) of PCB-containing equipment will require follow-up surveys before further clean-up action can be justified or recommended. The limited sampling and soil/vegetation structure will dictate future activities. The thin layer of vegetation over ice-laden soil (permafrost) creates a sensitive environment, and removing small quantities of PCB residue may be ill-advised.

Another factor considered in the site evaluations was the potential for release of PCBs to the environment. The pour point of Aroclor is 10°C (Hutzinger et al. 1974). Below 10°C the Aroclor becomes viscous, and when near freezing temperatures are reached, the Aroclor acts as a solid. In the arctic environment, the top few centimetres of soil are at ambient temperature; depending on soil type, ground cover and albedo effects, the ground temperature drops quickly with increasing depth (Embleton and King 1968). This can be illustrated best by using observations from Atkinson Point and Hat Island. The free PCB liquid appeared, as in the case at Atkinson Point, to remain within a small area around a leaking

piece of equipment when the ground was frozen. In the active layer, as in the case at Hat Island, the PCB liquid penetrated the soil until cold ground conditions prevented further movement. These factors should be considered significant in preventing release or spreading of any residual PCB left on the abandoned site, except where residues were left on the surface or migrating from old dumpsites. When the sites were cleaned up, the leaking equipment was removed along with 6 to 10 cm of topsoil. Non-contaminated soil was used to replace the removed material. This procedure ensured that surface contamination was removed as much as possible.

An unpublished draft guideline prepared for the Canadian Council of Resource and Environment Ministers (CCREM) suggests a safe level of 25-30 ppm for remote areas having occasional visitors. Because PCB residues are not easily absorbed through skin contact and the majority of PCB residues remain buried at the abandoned DEW Line stations, the risk to the environment or site visitors is minimal in the short term. Long-term risk needs to be assessed further. However, comparing the results of analysis for PCB residues in aquatic organisms, the Canadian Arctic levels are lower than other places in the world (Wagemann and Muir, 1984).

By burning excess oil, diesel and lubricants at many of the sites, further addition of these contaminants to the environment was prevented. At several sites, POL was left because of hazards to personnel or the environment. For example, at Stokes Point the grass/sedge groundcover surrounding the barrels was dry, thus representing a fire hazard. The sites where petroleum products could not be safely disposed of during the clean-up operation, as decided by the EP representative and the DND demolition expert, were left until further evaluations could be performed.

The PCB soil test kit appeared to be unreliable, possibly owing to cold air temperatures and inexperience of the operators. The presence of diesel fuel or mineral oil in most samples produced inconclusive results, adding to the unreliability of the kit. A method has to be developed to remove interfering substances from the soil before a kit of this type can be used in remote locations.

The soil sampling techniques used can only be interpreted as identifying potential hot spots (areas of contamination). The original intent was to use laboratory analysis only as a back-up for the field kit. However, because interfering substances made the kit unreliable, it became necessary to conduct laboratory analyses for site evaluations. Many of the samples (background and on-site) were taken with no prior indications of contaminants being present (stained areas or leaking equipment). Some samples were taken from known contaminant zones and represent the level of contamination removed and/or remaining. Areas were cleaned up based on the smell of the PCB/TCB mixture, but results reveal that this method did not result in a complete removal of contaminated soil, as at Hat Island.

The clean up of the abandoned sites could have been more effective if a pre-evaluation had been conducted using portable laboratory equipment and soil specialists. Hot spots could have been identified beforehand and cleaned up as crews moved through the area. This type of survey, however, would have taken two summers or considerably more personnel.

5.0 Conclusions and Recommendations

1. Surface contaminants and contaminated equipment have been removed from all the abandoned DEW line sites. The remaining residual contaminants at some of these sites should present no danger to humans from transient use, or to the environment. No clean-up operations should be conducted before a detailed sampling program has delineated the size of the problem.

2. The Horton River, Clifton Point and West Baffin sites were considered contaminant-free. It is recommended that no further evaluations are needed because all the PCB containing equipment has been removed, composite soil analysis indicates only low level residues remain and POL has been removed or destroyed.

3. Five sites are considered to still be contaminated for purposes of extended human use. The sites are Atkinson Point, Tununuk, Cape Peel, Kivitoo, and Sarcpa Lake. These sites met all of the following conditions:
   a) The presence of PCB residues (greater than 10 ppm.) in a sample of soil or a composite sample.
   b) Seasonal use by people for various activities.
   c) The evidence of PCB residues leaching from a dump site.
   d) Equipment known to contain PCBs was not accounted for in the inventory of equipment removed and evidence of buried material existed on-site.

   These sites should be considered a priority for re-evaluation, especially if continued use is anticipated.

4. Fourteen remaining sites may still be contaminated for purposes of extended human use because at least one of the following conditions are met:
   a) Equipment was missing from the site and no evidence of burial was evident;
   b) Low level contamination (less than 50 ppm) existed on site;
   c) POL remains at the site.

d) Equipment was removed (leaking) and soil samples indicated that residual PCB remained at this location.

These sites should require further evaluation if they are to be used as permanent installations (i.e. resorts, community centres or military establishments), or if the use involves contaminant-sensitive activities such as food processing or human habitation.

5. An inventory of all the communities near the abandoned sites should be conducted to determine if hazardous material was taken from the sites into the communities. For example, during the clean-up of the Keith Bay site, equipment missing from the site was located in the nearby community of Pelly Bay. This may be common to other communities in close proximity to abandoned sites.

6. It is recommended that a Priority Action Plan be prepared by the responsible agencies to deal with the residual level of contaminants remaining at the nineteen sites.

6.0 References

1. Andzans and Associates, DEW Line Data file, Department of Indian Affairs and Northern Development, Ottawa, 1984.

2. Embleton, C. and King, C., Glacial and Periglacial Geomorphology, Edward Arnold (Publishers) Ltd., London W1, 1968.

3. Environmental Protection Service, Inspection of the Fox Sector DEW Line Stations, (unpublished), Chris O'Brien, Western & Northern Region, Yellowknife, 1981.

4. Environmental Protection Service, Handbook on PCBs in Electrical Equipment, Department of Environment, Ottawa, 1982.

5. Envirotest Laboratories, Portable PCB Field Test Kit, Unpublished, Edmonton, 1985

6. Holtz, A. and Sharpe, M. A., Central Arctic DEW Line Inspection, July 18 - 25, 1984, (unpublished) Environmental Protection Service, Edmonton, 1984.

7. Hutzinger, O., Safe, S. and Zitko, V., The Chemistry of PCBs, CRC Press, Inc., Cleveland, Ohio, 1974.

8. National Research Council, Polychlorinated Biphenyls: Biological Criteria for an Assessment of their Effects on the Environment, NRCC No. 16077, Ottawa, 1978.

9. Underwood McLellan and Associates, Identification and Verification of Active and Inactive Land Disposal Sites in the Northwest Territories, (unpublished report) Environmental Protection Service, Edmonton, 1982.

10. Wagemann, R. and Muir, D. C. G., Concentrations of Heavy Metals and Organochlorines in Marine Mammals of Northern Waters: Overview and Evaluation, Canadian Technical Report of Fisheries and Aquatic Sciences No. 1279, Ottawa, 1984.

APPENDIX A

ANALYTICAL RESULTS

Appendix A

Results of PCB Analysis in NWT DEW Line Samples

Lab Sample #	Field Label		Aroclor	Estimated Amount**
85/0685	Matheson Point	Background		1*
0686	"	Beaching Area		1
0687	Stokes Point	Background		1
0688	Pearce Point	Oil from Transformer(pole mounted)	1262	2.3
0689	"	" " " (building site)	1262	2.1
0690	Atkinson	Dump 1, West side		1
0691	"	Dump 2, West side		1
0692	"	Dump 1, East side		1
0693	"	Dump 2, S.W. corner	1254	200
0694	"	Dump 3, W. side	1254	26
0695	"	Background		1
0696	Ross Point	Background		1
0697	Pearce Point	Background		1
0698	Tununuk	Site 2		1
0699	"	Site 4, Ravine bottom		1
0700	"	Soil from Transformer	1254	4.1
0701	"	Site 1	1254	10
0702	Bernard Harbour	On-site soil sample	1254	11
0703	"	Background sample	1254	1.0
0704	Horton River	Dump 1, large transformer	1254	2.9
0705	"	Dump 1, capacitor	1254	120000
0706	Clifton Point	Background	1254	5
0707	Cape Peel	Background	1254	6.2
0708	"	Soil from under leaking transformer	1254	4.4
0709	"	Dump-leaking capacitor	1254	140000
0710	"	On-site sample	1254	74
0711	"	After clean-up of leaking transformer	1254	2.4
0712	"	Dump after capacitor clean-up	1254	720
0713	Hat Island	Leaking capacitor outside door	1254	1100
0714	"	Burnt capacitor before removal	1254	310
0715	"	Burnt capacitor after clean-up	1254	730
0716	"	Soil under runway light regulator		1
0717	"	Outside of steps	1254	9.6
0718	"	Background		1
0719	Sturt Point	Below dump		1
0720	"	Sample from around shot-up transf.	1254	11
0721	"	On-site sample		1
0722	"	Background		1
0723	Rowley Island	#1 Composite,cement found.of warehs.	1254	24
0724	"	#2 Ground stains by building train		1
0725	"	#3 Base of power pole (W.of bldg.tr)	1254	2.6
0726	"	#4 On-site (background)		1
		I.T.)	1254	78

Sample #	Field Label		Estimated Aroclor	Amount**
0730	Padloping Island	#1 Seaward edge of dump		1
0731	"	#2 Seaward edge of dump		1
0732	"	#3 From beneath cabinet (equipmt.in)	1254	1.3
0733	"	#4 Between the two cabinets	1254	2.5
0734	"	#3 Surface		1
0735	"	#3 6" depth		1
0736	E. Fjord FOX C	#1 Base of stairs at main entr.(BT)	1254	11
0737	"	#2 Work area (near main entrance)	1254	2.7
0738	"	#5 Around stain		1
0739	"	#3 Ground stain		1
0740	"	#4 Surface of main site for backgrd.		1
0741	FOX E Durban Is.	#1 Surface sample (backgrd. on-site)		0.19
0742	"	#1 6" depth		1
0743	"	#2 Surface sample (backgrd.off-site)		1
0744	"	#2 6"depth		1
0745	Keith Bay	#1 Leaking capacitor		0.17
0746	"	#2 Leaking capacitor	1254	55
0747	"	#3 Leaking capacitor	1254	1300
0748	"	#4 Leaking capacitor		1
0749	"	#5 Leaking capacitor	1254	3.9
0750	"	#6 Leaking capacitor	1254	35
0751	"	#7 Background near building train	1254	2.4
0752	"	#8 Background away from bldg.train		1
0753	Simpson Lake	#1 Base of cabinets	1254	4
0754	"	#2 On-site background	1254	1.8
0755	"	#3 Tundra for background		1
0756	"	#4 Around motors - capactrs.removed	1254	13
0757	"	#5 Around motors - capactrs.removed	1254	19
0758	"	#6 Under motors - capactrs.removed	1254	1300
0759	West Baffin	#1 Downhill edge of dump	1254	2.6
0760	"	#2 Beneath leaking capactr.in dump	1254	57
0761	"	#3 On-site for background		1
0762	"	#4 Stain near building train		0.30
0763	"	#5 Work area	1254	2.5
0764	"	#6 Base of stairs at main entr.(BT)	1254	11
0765	Sarcpa Lake	#1 North entrance of building train	1254	59
0766	"	#2 Near building train	1254	10
0767	"	#3 Base of original dump	1254	190
0768	"	#4 Base of original dump	1254	1.6
0769	"	#5 Base of university dump		1
0770	"	#6 On-site for background	1254	5.7
0771	Kivitoo	#1 Ground stain		1
0772	"	#2 Work area	1254	1.2
0773	"	#3 Work area around cabinet 2		1
0774	"	#4 Composites from base of landfill		1
0775	"	Ashes from cabinet 1 f3 P4	1254	15000
0776	"	Ashes from cabinet 2 f3 P4		1

* all values represented by 1 are less than 1 ppm.
** Amount is in micrograms per gram of sample.

APPENDIX B

RECOVERY RESULTS

Appendix B

Recovery of PCBs from Spiked Samples

QC Number	Sample Number	Aroclor Added	Amount Added(ug)	Standard Deviation	Observed Spike(ug)	% Recovery
1	85/0699	NS	-		0	N/A
2	85/0725	1254	57.3	± 7.3	48	84
		1016	82.4	±18	83	100
3	85/0771	NS	N/A	N/A	0	N/A
4	85/0739	1254	115	±15	91	79
5	85/0767	1254	115	±15	N/A	N/A
6	85/0724	NS	N/A	N/A	0	N/A
7	85/0756	1016	82.4	±18	79	96
8	85/0712	NS	N/A	N/A	0	N/A
9	85/0725	1016	82.4	±18	77	93
10	85/0756	1254	57.3	± 7.3	65	113
		1016	82.4	±18	82	100
11	85/0685	1254	109	±20	116	106
12	85/0685	1016	114	±26	88	77
13	85/0685	1254	54	±10	59	109
		1016	57	±13	54	95
14	85/0685	1016	100	± 5	94	94
15	85/0685	1016	100	± 5	97	97

NS - No Spike added
N/A - Not Applicable or not able to determine quantity.